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THE COLLECTED WORKS

of

CHRISTIAN FENGER, M.D.

1840 — 1902

ILLUSTRATED

VOLUME I

PHILADELPHIA AND LONDON
W. B. SAUNDERS COMPANY
1912

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F332
1912

EXPLANATORY NOTE

NOT long after the death of Dr. Fenger, the Council of the Chicago Medical Society appointed a committee to form plans for some kind of adequate tribute in honor of the great surgeon and teacher. As a result of this step the Fenger Memorial Association was formed and a fund collected by subscriptions, the income from which will be used to promote medical investigation.

In response to requests from Dr. Fenger's assistants and pupils and to wishes expressed by many surgeons in various parts of the country, the Directors of the Fenger Memorial Association have caused to be published this volume, which contains nearly everything that Dr. Fenger has written. Discussions in medical societies and one or two reports of a statistical nature covering his work as prosector have been omitted. The articles published in Danish have been translated.

All the articles are reprinted without any other changes than those necessary to secure a reasonable degree of uniformity in the references and general arrangement.

Dr. Coleman G. Buford has collected the material and secured the permissions necessary to reprint it, and Dr. Ludvig Hektoen has acted as editor, both working under the authority of the Directors of the Fenger Memorial Association.

CHICAGO, ILL., *April*, 1912

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COLLECTED WORKS
OF
CHRISTIAN FENGER, M.D.

AUTOBIOGRAPHY*

I was born at Breininggaard, Breininge Sogn in Ringkjöping Amt, November 3, 1840. My father, Kammerraad Hans Fritz Fenger, was the owner of Breininggaard, and was there married to my mother, Frederikke Mathilde Fjelstrup, daughter of Etatsraad Fjelstrup, the owner of Sindinggaard in Holstebro Amt. In 1848 my father moved to Nordgaarden near Ringsted. In 1851 I entered Herlufsholm school, where I graduated in 1859 with marks of the second grade.

Love of the natural sciences led me to begin at the Polyteknisk Läreanstalt with the object of passing the examination for civil engineer, but after one year I yielded to my father's wishes and commenced to study medicine, and in the winter of 1860–61 I passed the "examen philosophicum" with the grade of "Laud." In 1863 I passed the first medical examination with good marks (anatomy, zoology, chemistry, botany). During my studies I earned part of my expenses by teaching in Melchior's High School, and later by giving instruction to medical students in anatomy and by coaching students of dentistry for their examinations. My father had twelve children, and struggled hard in order to give nearly all of the seven sons an opportunity to study. In 1864 I served as assistant physician at Augustenborg Lazareth, under Studsgaard, physician-in-chief, whom I always think of with admiration and friendship. A few years previously my father had bought a large farm (Augustenborg Ladegaard) and my home became a pleasant gathering place for many Danish officers until the unfortunate crossing of Als drove our army on to Fyen, where I was assistant physician for a battery at Assens. After the war was ended I continued the study of medicine, passed the examination for the practice of medicine in 1866–67 with the grade of "Laud."

Dr. Vilhelm Meyer, who had shown me great friendliness during a sickness while I was a student, now appointed me as amanuensis in his ear clinic and in his private practice, and here I had the opportunity to take part in the investigations which led to Dr. Meyer's celebrated article "Concerning the Adenoid Vegetations in the Naso-Pharynx." In 1869 I entered as interne the Royal Frederik's Hospital. Professor Mathias Saxtorp, chief of the surgical division, had opposed my appointment because I was amanuensis to "German" Meyer. Mayor Ehlers, to whom I owe so much for friendship and help through many years, assisted me to obtain the position as interne. During the two years which I served as interne not a word was spoken between Professor Saxtorp and me.

---

*It is required of everyone who receives the order of Knight of Dannebrog that he furnishes a sketch of his life, and accordingly on January 1, 1902, while staying at the Hotel Coronado in San Diego, Cal., Dr. Fenger wrote this autobiography in Danish.

During this time I wrote an essay on a prize topic in medicine, "Concerning Subperiosteal Operations (Ollier) and Evidement (Sedillot)," which was accepted by the university; at the same time I made experiments concerning gunshot wounds of horses at the Royal Veterinary College, and constructed instruments for the purpose of finding bullets in the tissues and taking them out, and a paper entitled "Concerning the Endoscopy of Gunshot Wounds" led to a grant from the Royal Danish Ministry of War to assist me to take part in the Franco-German war of 1871. In January, 1871, I was appointed by Professor Socin of Basel to an international ambulance on the battlefield of Bourtaki-Werden (Haute Saône), where I worked until the end of the war and wrote a report on endoscopy of gunshot wounds.

After the war I went to Vienna, where I studied pathologic anatomy and surgery, returning to Denmark in the winter of 1870–71 [?]. By means of the assistance of Etatsraad Ehlers I was appointed in 1871 prosector to the Communehospital, where I wrote my thesis for the degree of Doctor of Medicine, "On Cancer of the Stomach," which I defended in 1874, and also several other papers, which were printed in Nordiskt Medicinsk Archiv (Acute Hydronephrosis, Gonorrheal Rheumatism, Endoscopy of Urethra, Stenosis of Ostium Pulmonale), whereupon I received one of the Smith grants for advanced studies.

In 1875, during the illness of Professor Rasmussen, I was appointed docent in pathologic anatomy and instructed the students in this branch, in which Professor Reiz held the examinations. Professor Reiz told me that my students passed just as good examinations as those who had done the work previously under his own direction, which was an encouragement coming from a man whom I always think of with admiration and gratitude for friendship through many years.

At this time the professorship of pathologic anatomy became vacant by the death of Professor Rasmussen. I was prepared to take part in the competition for this professorship, but, inasmuch as the place was given to Professor Carl Lange without competition, I felt that my road to an academic career was blocked. I resolved to leave Denmark in order to reach an independent position more rapidly, but I had no money, and at this point Etatsraad Ehlers again came to my assistance with a gratuitous loan which I was able to return fourteen years later. My gratitude to him for advice, help, and friendship will last always. I was not disappointed or depressed because I did not obtain the professorship in pathologic anatomy, and for the following reasons: I had always been greatly interested in surgery and had regarded the study of pathologic anatomy and pathology as the means of entering surgery as my final object, my work in surgery having already been commenced in the two wars in which I had taken part. Assistant-surgeon at the Frederik's Hospital I could not become because of my relations with Professor Saxtorp. The same position at the Commune-hospital had been filled just as I had ceased to be prosector for that hospital. I consequently could not see any immediate opportunity to commence the further study of surgery. Inasmuch as surgery interested me more than pathology, it was in reality a help for me that Professor Carl Lange was appointed, because it freed me from the obligation of continuing with pathology as my life's work, and gave me the right to seek elsewhere opportunities where I might be able to dedicate myself to surgery.

My brother, Dr. Sophus Fenger, had emigrated to Egypt in 1873, and practised medicine in Alexandria. In the spring of 1875 I went to Alexandria in order to assume his practice while he visited Denmark in order to be married; as he returned the next winter, I went to Cairo, where I resided with my friend, Dr. Bull. In Alexandria I did not receive much help from the Danish Consul Dumreiter, to whom I brought letters of recommendation from the Royal Danish Minister for Foreign Affairs, but rather from the Norwegian and Swedish general Consul, Mr. Anker Boedtker, who was a faithful friend and helped me to become a member of the Board of Health,—"Conseil Sanitaire,"—later to an appointment in Cairo as "Medicin du Quartier der Kalifa," a salaried position as district physician under the lovable Dr. Ahata Bey, chief of medical affairs in Cairo. Here I investigated Egyptian eye disease—trachoma—in the children in the public schools, which was followed by a report about it to the government.

After the war in Abyssinia in 1875 an epidemic disease of horses and mules was brought into the country, and all the horses in Cairo died. I was ordered to investigate this disease, and made a series of postmortem examinations, followed by a report to the government. In 1876 I was attacked by dysentery, followed by inflammation of the liver, which interrupted my investigations in the large military hospital, Kasr Elajan, "Concerning Distomum Hæmatobium Bilharzii," and in the winter of 1876–77 I was compelled to go to Europe to Mentone, in order to get well. The Egyptian government granted me leave of absence with full pay during this time, and at the end of the winter I returned to Cairo quite well.

After a little, in the spring of 1877, the liver disease again appeared, and I was compelled again to go to a temperate climate. In Cairo I had been physician for a part of the American colony, and among them certain American officers, whom Khedive Ismail Pasha had brought in in order to reform the Egyptian army. Following the advice of Captain General Stone's amiable wife, a near relative of the poet Longfellow, I resolved to go to America—so much the more as an American officer in the Egyptian service, Major Irgens, on leave of absence on account of disease after the Abyssianian war, wished me to accompany him to Bloomington, Ill., where he was well acquainted. I now resigned (June, 1877), and traveled by ship from Alexandria to Liverpool, and further on to New York.

I received no encouragement to locate in New York, and traveled on to Chicago, in order to get through to Bloomington or to San Francisco, possibly to practise ophthalmology. My able and lovable countryman, Dr. S. D. Jacobsen, resided in Chicago. When I asked him for advice with reference to my plans for the future, he told me that I might as well locate in Chicago as any other place, and especially since my funds were practically exhausted. I then lived in a Scandinavian part of the city and had a little practice.

In the spring of 1878 I secured, by means of borrowed money, a place as physician to Cook County Hospital, and here I commenced to give lectures and demonstrations in pathologic anatomy, a science which was unknown to the physicians there. The following year I served on the surgical services when my colleagues were away on their vacations. At this hospital I served first as pathologist, later as surgeon for twelve to fourteen years, and introduced the antiseptic—Lister's—operative methods.

In 1880 I became curator of the Rush Medical College museum; in 1884, Professor of Surgery in the College of Physicians and Surgeons, and Surgeon-in-Chief at the Passavant Hospital and the German Hospital, when these two hospitals were founded. In 1893 I assumed the professorship of surgery in the Chicago Medical College, later the Northwestern University Medical School, and became surgeon to the Hospital of the Sisters of Mercy. In 1899 I left this medical school in order to fill the chair of Professor in Surgery in Rush Medical College, in affiliation with the University of Chicago, with a surgical service in the Presbyterian Hospital. In 1894 the Norwegians in Chicago erected the Lutheran Tabitha Hospital, and I accepted the position of Surgeon-in-Chief.

In the course of these twenty-four years I have written every year three or four articles concerning surgical studies, which have been published in the American medical press. In 1898 I was requested by Professor Guyon, in Paris, to present a report concerning "Surgical Operations in Conditions of Retention in the Kidneys" to the International Medical Congress in Paris, in 1900, together with Professor Küster, in Marburg, and Professor Bazy, in Paris, as coreferees. This article was published in Germany in Langenbeck's Archiv für klinische Chirurgie, and in America in the Annals of Surgery. In 1895 I was Vice-President of the American Surgical Association, and in 1901 President of the Chicago Medical Society and the Chicago Surgical Society.

In 1900, on my sixtieth birthday, a testimonial banquet was given me in Chicago by about five hundred physicians, consisting of pupils and friends—a fine example of the willingness of the Americans to recognize the work that I have been able to carry out in their midst. I was presented with a loving-cup, on which were engraved my portrait and an inscription from the American medical profession, and an album, from the celebrated surgeon, Nicholas Senn, my colleague in Rush Medical College, containing the autographs of those present. In 1891 it pleased His Royal Highness, King Christian IX of Denmark, to honor me with the order of Knight of Dannebrog. For this honor from my native land I wish to present to his Majesty the King my most humble thanks.

In 1878, in Chicago, I became acquainted with my wife, Caroline Sophie Abildgaard, daughter of M. C. Abildgaard, now owner of a farm near Clifton, Ill., previously owner of Björnsstrup in Hjörning Amt in Jylland, where she was born in 1857, and whence she emigrated when five years old. She has been a faithful helper in the hard struggle to "make it go" in a strange land, a struggle which a happy home alone made it possible to bring to a successful end. We have one son, Frederick A. Fenger, nineteen years, who is a student at Cornell University, and a little daughter, Augusta Maria Fenger, seven years old. With gratitude and love for my old as well as for my adopted country, for all the help and all the good things which they have given me richly and without merit on my part, I shall endeavor as best I can to live and to act like a good son of them both.

ENDOSCOPY OF THE URETHRA*

A CONTRIBUTION TO THE LOCAL TREATMENT OF GONORRHEA

UNDOUBTEDLY one of the most important steps in advance in medicine in recent years is the introduction of the use of reflected artificial light. The great aid thereby afforded us in the diagnosis, prognosis, and treatment of diseases in the eye, the larynx, and the ear hardly needs mention. The urethra has not been neglected, the great frequency of its diseases leading to efforts to accomplish more by treatment than has been the case.

Desormeaux made the first effort in this direction by the construction of his endoscope, which he presented to the Academy in Paris in 1852, with reports of the results of observations and local treatment of diseases in the urethra. That this was an important step is shown by the fact that able men in practically all European countries rapidly took up this work; new instruments were constructed, the chief object of which was to intensify the light; new observations were made, and new forms of treatment introduced, so that at present there exists a special literature on the subject. To discuss this fully is not my intention now, nor is it my purpose to consider the endoscope critically and the progress achieved by its help. I wish to emphasize that Desormeaux's endoscope still remains in the hands of the specialists, and that only a few of these avail themselves of its advantages in chronic diseases of the urethra. As these advantages are not inconsiderable, the reason for the restricted use of the instrument must depend on either defects in the instrument itself or on difficulties in the method of its use that hinder its practical use.

The first and most important obstacle is that the endoscope is quite expensive (300 francs), and then its construction is complicated. An improvement was introduced in 1867 by the American Wales, who fastened a perforated, concave mirror to the usual Desormeaux tubes; the light is obtained from a source outside the endoscope. This instrument has not yet been used in Europe.

In the spring of 1870 I had in my care a case of gonorrhea which would not yield to any of the usual local and general measures. I succeeded in obtaining a direct view of the diseased mucous membrane, and in directly treating it by means of the following procedure:

With Liebreich's ophthalmoscope I directed sunlight in the urethra through a tube 13 cm. long, so that the mucosa could be inspected as the tube was withdrawn; but as sunlight is not always obtainable when it is wanted, I have tried to secure a lamp that would answer the purpose fairly well. The following may be recommended: a petroleum lamp with a round burner, 30 mm. in diameter; on one side of the flame should be a concave mirror, and on the other a glass ball containing water or glycerin. The lamps used for laryngoscopy may be changed so as to answer the purpose. As the direction of the light has to be changed frequently, it is best to use a movable stand. As it is desirable to use both hands, I prefer to attach the mirror to the forehead. The tubes through which the light is thrown in are supplied with a "bouton," and their interior surface is blackened. The length of the tubes I use is 10, 13, and 16 cm., and the caliber varies—I have used tubes the thickness of which corresponds to No. 16, 18, and 20 Charriere. The tube is introduced after having been dipped in oil, and then the obturator or "bouton" is removed; the light is now thrown in and local applications made. I have used pencilings with copper sulphate as well as with liquids.

---

* Hospitals-Tidende, 1871, vol. xiv, p. 25. Somewhat abbreviated in the translation.

These instruments were used in the following cases:

1. S., thirty years old; strong, well nourished; works in an office. In June, 1868, he acquired gonorrhea for the first time. The attack yielded to the usual treatment after six to seven weeks. In the spring of 1869 symptoms of gleet became apparent, which subsided after a few months of vigorous treatment, to reappear in acute form on intercourse. Epididymitis developed on the right side. Eventually the discharge ceased again, but in March, 1870, it reappeared. In June of this year endoscopy and local treatment. There were no strictures or tender points in the urethra; the mucosa of the pars membranacea was deep red in color for 6 to 7 cm.; no granulations. Penciled with copper sulphate once, later twice, a week after about eight weeks' definitive cure.

2. V., thirty years old; well and strong; had several attacks of gonorrhea in the four years preceding September, 1870, resulting in a chronic discharge. There was a red area, about 5 cm. long, in the posterior part of the urethra, covered with a whitish discharge containing pus and epithelial cells. After about seven weeks of local treatment with copper sulphate complete cure.

3. Dr. Krenchel permits me to mention a case which he has treated in the same way. Here there was redness near the pars membranacea, as well as over an area anterior to it. The discharge appeared to cease after penciling with solid copper sulphate.

In the cases described copper sulphate was the only local application used. Desormeaux, who uses nitrate of silver solution, 1 : 1, or 1 : 2, gives the length of the treatment as two to three months. In my two cases the treatment lasted about two months. Fürstenheim assigns no time limit, but advises the continuation of the treatment even after the mucosa has regained its normal smoothness, so long as there is redness where before were granulations. I found no granulations in my cases. As the "bouton" is removed the patient often complains of a sting at the end of the tube. The copper sulphate does not cause any pain, outside of an insignificant smarting, which passes away after a few minutes. Only once was there smarting on subsequent urination. The patient may go about his work immediately after being treated, and he soon feels that the treatment is beneficial, especially as the discharge soon diminishes. The view obtained of the urethra is sufficient to recognize redness and small amounts of mucus, though at first the efforts to recognize the conditions of the urethra may not give very satisfactory results.

Through the courtesy of Dr. Plum I have been able to compare my instruments with those of Desormeaux. To my surprise I find that one does not obtain so good a view through the endoscope as with the tubes and mirror. On the other hand, it is easier for the beginner to see the urethra with Desormeaux's endoscope, because the relative positions of the lamp, the mirror, and the tubes are fixed. It is easier to carry in the applicator though my tubes than through the slit in the side of Desormeaux's tube, and also easier to remove mucus for microscopic examination.

The form of the cells in the mucus gives a good indication of the cause, and I believe that treatment may be suspended when the urethral orifice is dry and when the mucus contains fully developed, flat, epithelial cells, with only an occasional smaller cell here and there. I assume that the urethra then is covered with normal epithelium. The sign is better than the disappearance of the redness, because it is difficult to judge accurately of the varying degrees, and as some redness persists for some time after the epithelium is reformed.

ENDOSCOPY OF GUNSHOT WOUNDS*

DURING the Franco-Prussian war just ended it was not possible, as I had hoped it would be, to make observations on endoscopy of gunshot wounds. On the journey out I found that in the larger hospitals, as in Berlin, Frankfort, and Strassburg, there were no patients with wounds suitable for exploration; and when sent by the International Committee in Basle to the battlefield at Bourtaki-Werden, I reached it about three weeks after the battle. In connection with the ambulance which was stationed at Lure, a little town in Haute-Saône, between Belfort and Vesoul, I assumed charge of a division which was established after my arrival, and here I had the opportunity to examine a few older wounds. While I have no results of practical value to present in regard to endoscopy, I wish to report two observations, because they illustrate the use of the method:

1. Louis Gagnol, infantry, twenty-three years old; wounded January 17, 1871, in soft parts on anterior surface of left thigh. He was dressed once a day by the persons in a private lodging-place, and came to the ambulance every third or fourth day. As the suppuration continued freely, as there was no tendency of the openings to close, an endoscopic examination was made March 1st. The entrance was situated 3 inches above the patella, on the inner side of the anterior surface; the canal passed 2½ inches upward and outward, so that the exit was about 5 inches above the patella. Tubes 10 mm. in diameter were easily introduced. Everywhere the canal was covered with large, pale-red granulations, and there was no foreign substance or dead tissue. The examination caused no bleeding, only little pain, and no increase in the suppuration.

2. Louis Guillemot, infantry, twenty-nine years old; wounded January 17, 1871, in the external and posterior part of right thigh. As suppuration continued without any tendency to healing, the wound was examined with the endoscope March 2d. The entrance was in the middle of the posterior surface of the thigh, and the canal passed 2½ inches upward and outward, to a rather large exit surrounded by flabby granulations. The endoscope introduced through the wound of exit showed pus and blood; after removing this the walls were found to be covered with large, pale, flabby granulations. No foreign body. There was but little complaint of pain. No increase in suppuration.

In the fourth and fifth week after the lesions I found the canals of the wounds so narrowed that the tubes could not be introduced, and it seems to me that endoscopy is best suited for fresh wounds.

The observations I have made on older wounds have not given any positive results; that is to say, they have not revealed any foreign bodies, but they do throw light on the practicability of endoscopy, and remove some of the objections that might be made against it. The following conclusions may be made:

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* Hospitals-Tidende, 1871, vol. xiv, p. 77.

(1) Endoscopic examination does not present any serious practical difficulties. My colleagues in the ambulance, Dr. Burckhardt and Dr. Baader, from Switzerland, used the instruments offhand without any previous practice, and they as well as I found—(2) that the walls of the wound can be inspected closely and, if desired, treated locally; (3) that the method is not especially painful; that it did not cause bleeding or

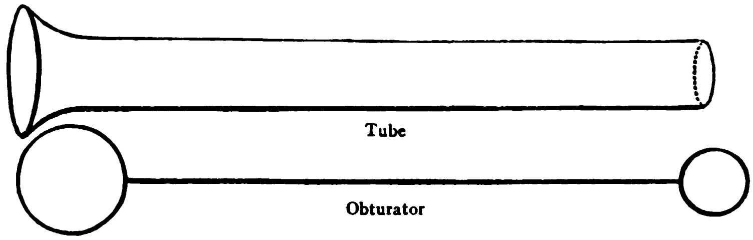

Fig. 1.

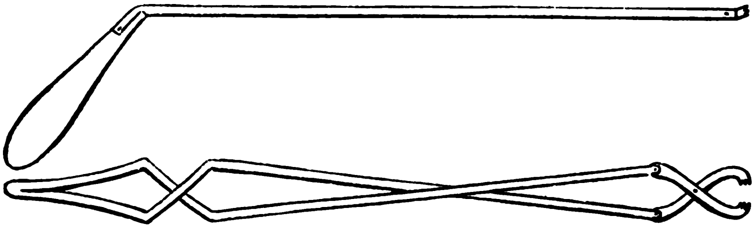

Fig. 2.

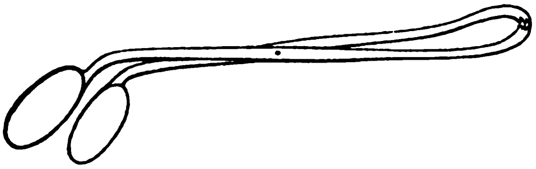

Fig. 3.

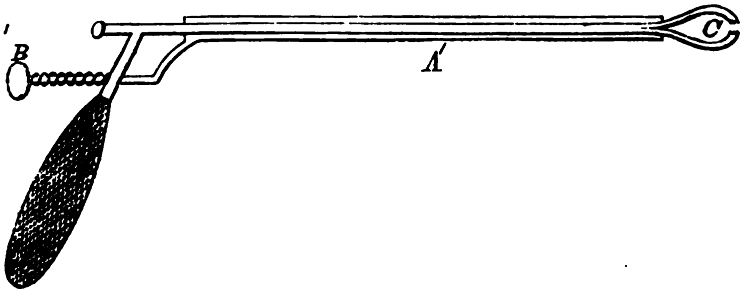

Fig. 4.

subsequent irritation to such extent as to hinder endoscopy of older granulating canals after gunshot wounds.

There is, however, one positive result to be emphasized, namely, the demonstration of the absence of a foreign body where the symptoms pointed to its presence. Consequently the cause of the continued suppuration had to be sought in other directions, such as absence of quiet, general and local conditions, etc., and in this way were secured more definite indications for treatment. It would not be safe to place a compressive bandage over a gunshot wound containing a foreign body, but in the absence of any such body, the approximation of the walls of the canal often promotes healing.

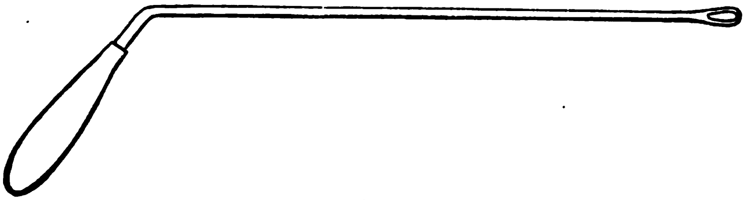

Fig. 5.

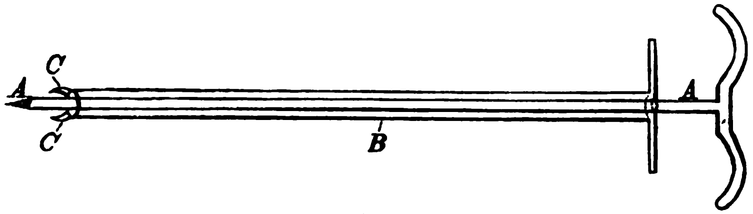

Fig. 6.

While the experiments and observations do not permit of any final judgment of the value of endoscopy in military surgery, I feel at liberty to recommend the method and the instruments to military surgeons for use in suitable cases, in the hope that endoscopy may prove to be of value in the examination and treatment of gunshot wounds.

STENOSIS OF THE PULMONARY ORIFICE AND OF THE PULMONARY ARTERY CAUSED BY VEGETATIONS ON THE VALVES

ILLUSTRATED BY A CASE*

BOY, aged eleven. Entered the hospital August 4, 1864. He complained of sudden pains in the right chest, at the level of the second rib, radiating to the right side of the back, where they were felt most intensely.

Present Condition.—General appearance is normal. Respiration, 24; pulse, 92. There is a marked pulsation in the precordial region, especially in the second and third intercostal space. The heart dullness extends from the upper margin of the third rib to the sixth. The width is normal. The apex impulse can be felt in the fourth intercostal space, just inside the mammary line. A rough murmur is heard during the first sound, and extending through the intervals. This is most distinct at the base, especially over the second intercostal space, near the sternal border. Its intensity decreases toward the apex. In the second intercostal space, on the right, the heart-sounds are scarcely audible. The murmur is heard in the vessels of the neck, and it can be heard also over the course of the descending aorta in the back, and less distinctly over the entire chest. The lungs are unchanged. The urine normal. The pains disappeared after six cuppings over the precordia, and six days later he was discharged as well. Eight years after this—on June 20, 1872—he entered the hospital again, and was assigned to Professor Aarestrup, who has been kind enough to permit me to publish the case, for which I am happy to express my thankfulness.

Past History.—The father died from tuberculosis. As a child the patient suffered from ophthalmia; has had measles, but not scrofula. During the last two years he has suffered from dyspnea and palpitation of the heart, and often hoarseness and troublesome cough. Four days previous to his entrance he was suddenly taken with a sticking pain in the right chest and felt sick all over.

Present Condition.—The body is rather thin. Varicose capillaries are present in the face. The tip of the nose and the lips are cyanotic. Temperature, 38.5° C.; pulse, 110, strong, and somewhat hard. The patient complains of pain in the right side upon coughing, when he takes a deep breath, or when he lies on the right side. The cough is not exhausting, but associated with a scant serous expectoration streaked with blood. The voice is hoarse. While in bed, the patient is fairly comfortable. He breathes nearly normally, and no palpitation of the heart is present.

Inspection.—A diffuse pulsation is seen in the precordial region, extending into the vessels of the neck.

Percussion.—The heart dullness is increased, and extends from the third rib to the fifth space, and from a fingerbreadth inside of the left margin of the sternum. In the back there is defective resonance over the right infraspinous and interscapular regions, and also on the left, from two fingerbreadths over the angle of the scapula, extending downward.

Auscultation.—There is heard a loud systolic murmur, which continues through the interval and ends in a sharp click (the second sound). The murmur is heard most distinctly over the base, and is plainly audible along the left border of the sternum as far as the base of the ensiform cartilage; it also extends up into the vessels of the neck. It is faint at the apex. The second sound is inseparable from the murmur. There is bronchial respiration over the right angle of the scapula; otherwise the respiratory sounds are decreased over the areas of defective resonance. There is a discharge from the left ear.

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* Nord. med. Archiv, 1873, vol. v.

The abdomen is rather rigid. No edema. The urine is rich in albumin. In the course of the following days the pain gradually disappeared, but the dullness in the right infrascapular region continued.

June 25th: Nausea, vomiting, and pain in the groins. Temperature, 37.8° C. A. M., 39.6° C. P. M., Pulse, 100 A. M., 120 P. M.; regular and strong.

June 26th: Some drowsiness; vomiting. He is so weak he is scarcely able to sit up. Percussion on the right side of the back shows the dull areas diminishing.

June 28th: The condition is unchanged. Bronchial breathing and bronchophony over the left infrascapular region. Vomiting and drowsiness increased.

June 29th: Bronchial respiration heard over the left angle of the scapula.

June 30th: Vomiting continues. There has been 14 involuntary stools. The percussion is clear, and the respiration is vesicular in the back and the right side. On the left side there is bronchial respiration over the entire infrascapular region and over most of the infraspinous portion. The tongue is coated.

July 2d: Temperature, 38.5° C. P. M.; 40° C., A. M. Pulse, 136 P. M.; 120, A. M. He is more stuporous and dyspneic. The diarrhea continues. The spleen is enlarged, and is felt three fingerbreadths below the costal arch. The abdomen is tender. Auscultatory findings unchanged. Dead in the evening.

Autopsy July 4, 1872, thirty-seven hours after death. The body is markedly emaciated; length, 161 cm. Rigor mortis is present. The pericardium contains about 10 cm. of a clear, yellowish, serous fluid. The heart is enlarged, and measures 11 cm. across the base, the length being 12 cm. The right heart is enlarged, although it does not reach the apex. The width is 8.5 cm., and the distance anteroposteriorly is 8 cm. The wall is very firm and hypertrophied. On the anterior surface the hypertrophied muscular bundles appear through the pericardium as slightly raised stripes. The ventricular cavity is slightly enlarged, so that the walls are not in contact. The papillary muscles and the trabeculæ are markedly increased, especially at the base, both in the conus arteriosus and in the conus venosus. Here the wall is 2.5 cm. thick, and only 12 to 13 mm. is made up of the musculature of the wall itself; the rest is the hypertrophied trabeculæ. The musculature is somewhat pale; it is firm, and of an even, grayish-red color. The right tricuspid orifice admits three fingers readily.

On the auricular surface, at the free margin of the outer segment, are four pedunculated vegetations about the size of a hempseed. These are of yellowish color. A single bluish growth as large as a pea is located on the margin between the anterior and posterior cusps. When this is laid open, it is seen to consist of a pigmented capsule inclosing a grayish network, similar to that of the other excrescences. The apex of the conus arteriosus and the origin of the pulmonary artery are both markedly narrowed, and admit only the tip of the little finger. The endocardium of the conus arteriosus is roughened, and 1.5 cm. below the orifice are two pea-sized, irregular, whitish-gray spots. The remaining parts of the right heart are normal. On account of the retraction of the orifice the segments are of equal height and width.

A rough vegetation, 10 to 12 mm. long, 6 to 7 mm. wide, and 2 to 3 mm. in thickness, is located in the middle of each segment, right on the line of contact. This vegetation is somewhat flattened, of a grayish-white color, and of a semisolid consistence, pointing in the direction of the blood-stream. Besides these larger excrescences, there are numerous smaller ones, located partly on the free border of the segments and partly on the pulmonary surface. Immediately above the anterior right segment, in the pulmonary artery, there is located a group of eight hempseed-sized vegetations, and 2 cm. above the valves, right at the bifurcation of the artery, the wall is covered with a large mass of pedunculated growths,—as many as 60,—varying in size from a pinhead to a hempseed, some at the angle of division being as large as a small nut. Between and on these growths are numerous old and recent thrombi.

In the left branch of the pulmonary artery the vegetations extend nearly up to the hilus of the lung, but in the right they reach only to within 3 cm. from the hilus. A No. 16 catheter passes with difficulty through the lumen between these growths. At this point, for about 1 cm., the artery is dilated, so that the diameter here is 2 cm., as compared with 1.5 cm. at the origin of the artery. The dilatation extends into the inner half of the left pulmonary branch of the artery. The wall of the artery is thickened at the dilatation, and its intima is roughened and rather pale. The right auricle is dilated, and its wall thicker than normal.

The foramen ovale and the ductus Botalli are closed. The left ventricle is of normal size and shape. Its wall is 1.5 cm. thick. The musculature is somewhat pale, rather dull, and soft. The mitral valve and the endocardium are unchanged. On the corpus aurantii of the posterior and left aortic cusps is situated a pedunculated vegetation of the size of a hempseed; otherwise the valves are normal. The diameter of the aorta at its origin is 1.5 cm.; in the ascending aorta it is 17 to 18 mm. The wall is unchanged. The vegetations have a grayish, smooth surface, on which are found scattered secondary growths.

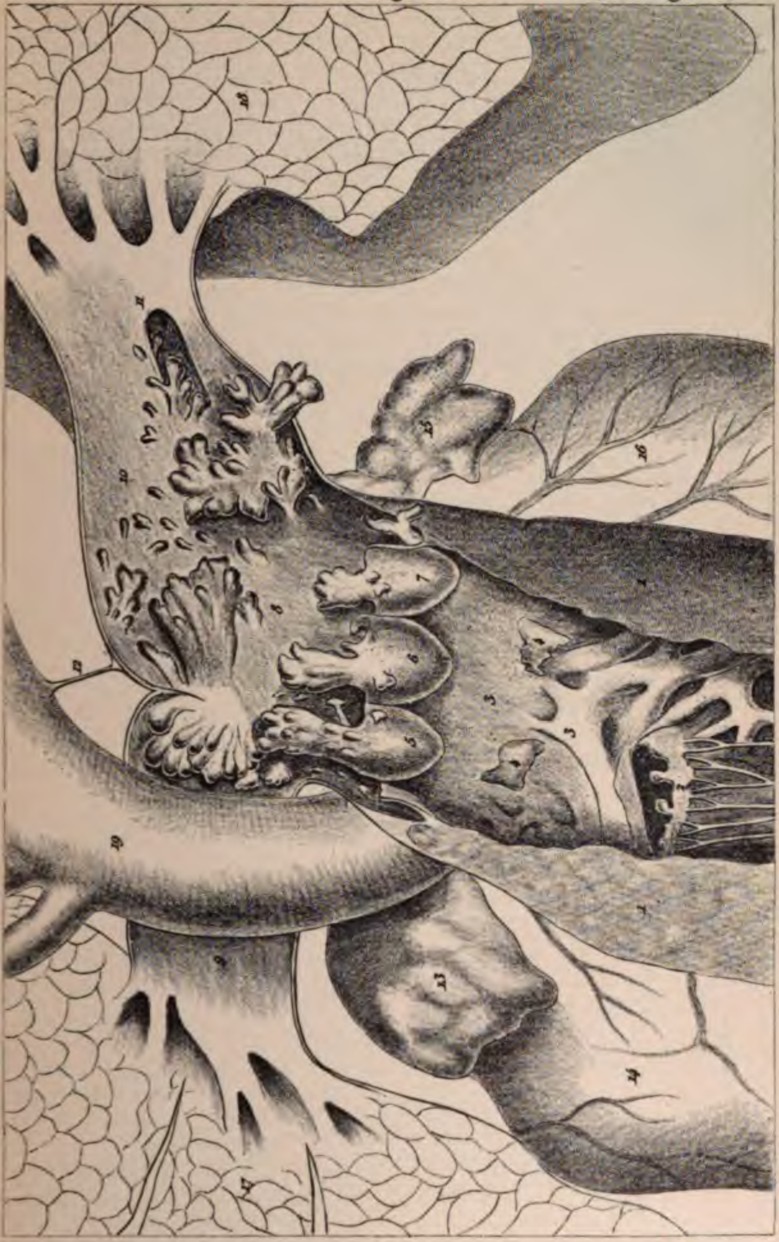
Microscopically, the tunica externa and media of the dilated part of the pulmonary artery are normal, but the intima is greatly thickened in places; especially is this marked at the origin of the vegetations. Here large groups of small round-cells are found between the slender connective-tissue bundles of the deeper layers of the intima. The vegetations themselves consist of a fine-meshed connective-tissue network containing few small round-cells. This network radiates out from the deeper granulating focus of the intima and from a radiating or branching nucleus. Outside of this is a layer of homogeneous, strongly refractile, gelatinous network. Then, at the very periphery of the vegetations, there is a thin fibrous network which is a continuation of the non-nucleated layer of the intima. I have been unable to find any epithelium, nor are any vessels present. Apparently, then, the growths have originated from the deep layer of the intima, and consist of a non-vascular network, which is fibrous in the center and gelatinous on the outside, and the whole growth is covered by a thin, superficial layer of the intima.

The left pleural cavity contains about 250 c.c. of a yellowish fluid, and the lower lobe of the lung is covered with a thin, fresh layer of fibrin. The lung tissue of the upper lobe contains air, except a part about the size of a hen's egg near the upper margin. Here the lung is solid and appears granular, and of a grayish-red color in cross-section. The greater part of the lower lobe is in the state of red hepatization. In the right pleural cavity there is also about 250 c.c. of a turbid serous fluid, and the right lower lobe has a fibrinous covering similar to that of the left.

There is a solid portion as large as a walnut at the apex of the upper lobe, which is pigmented and traversed by strong bundles of white fibrous tissue. Between these bundles are dilated bronchi containing cheesy masses. The rest of the lung crepitates, and is rather firm and resistant. There are two red infarcts at the lower margin of the lower lobe. In the smaller branches of the pulmonary artery the walls are unchanged. From the peritoneal cavity is withdrawn 300 c.c. of a thin, purulent liquid, and in the lesser cavity are found three large fibrinous clots. The small intestines are glued together by numerous recent fibrinous adhesions. Similar exudates are found on the abdominal wall, the liver, and the spleen.

The spleen is markedly enlarged, measuring 22 cm. by 10 cm. The liver and the mucosa of the digestive tract are normal. The right kidney is of normal size, being 10 cm. long and 5 cm. wide. The capsule strips readily. The surface is smooth, with grayish spots. The cortical substance is also mottled and striped. The pyramids are striped at the base, and somewhat edematous, so that the parenchyma is rather soft. The left kidney is similar to the right. The ureters and the bladder are unchanged.

Chr. Fenger · Stenose af ost. pulm. og art. pulm.



Thornam sculp

Fig. 7.—The drawing is natural size. The right ventricle has been cut open close to the septum. The pulmonary artery has been slit open along the anterior wall as far as the lungs. 1, 1, Right ventricle, markedly hypertrophied; 2, the tricuspid valve with two small vegetations; 3, 3, right conus arteriosus; 4, 4, two white scars from previous endocarditis; 5, right posterior pulmonary cusp; 6, left posterior pulmonary cusp; 7, anterior pulmonary cusp; 8, stem of the pulmonary artery; 9, right branch of pulmonary artery; 10, left branch of pulmonary artery; 11, a large branch to the lung, with vegetations; 12, ligamentum Botalli; 13, right auricle; 14, right ventricle; 15, left auricle; 16, left ventricle; 17, right lung; 18, left lung; 19, aorta

The cranium and the dura mater are normal. The vessels of the pia contain a medium amount of blood. The subarachnoid space is filled with a yellow, serous fluid. On removal of the brain a moderate amount of a somewhat turbid yellow liquid escapes. Around the blood-vessels, on the lateral side of the right hemisphere, is found a marked amount of a gelatinous exudate, which extends all the way down on the temporal and frontal lobe, but disappears toward the midline at the base. On the left hemisphere there is edematous infiltration of the pia mater, which is readily removed from the moist surface of the brain. The lateral ventricles contain a small amount of a clear serous fluid. The ependyma is unchanged. The parenchyma of the brain is somewhat pale and moist; otherwise it is normal.

Anatomic Diagnosis.—Endocarditis of the pulmonary, the tricuspid, and the aortic valves; polypoid endarteritis of the pulmonary artery, with stenosis; hypertrophy of the right heart; infarcts of the right pulmonary artery; croupous pneumonia of the left lung; swelling of the spleen; diffuse peritonitis; parenchymatous nephritis; meningitis of the right hemisphere.

In order to elucidate this rare condition, I wish to consider inflammation of the pulmonary orifice and its immediate neighborhood.

Endocarditis and endomyocarditis are found, in the large majority of acquired infections, in the left heart. During intra-uterine life the condition is reversed, so that the right heart is nearly without exception the site of the lesions, whereas it is a great rarity that diseases occur here after birth. It is plain that the results of an infection of the infantile heart must be vastly different from the effect produced on the fully developed organ. The symptoms, too, become so different that it is very possible to tell from them whether the lesions of the right heart are congenital or acquired.

A. Congenital Infection of the Pulmonary Orifice

The pulmonary orifice is the most frequent and perhaps the only site of congenital endocarditis, and it is always complicated with stenosis. Peacock* collected 112 cases of congenital stenosis, but none of inherited insufficiency. This must be due either to the fact that only the chronic form of endocarditis occurs during intra-uterine life, or the ulcerative form is so acute as to kill the product of conception in utero. There are, as far as I know, not a sufficient number of autopsies of aborted fetuses reported to decide this question.

The pulmonary stenosis is accompanied with an incomplete ventricular septum or a patent foramen ovale, depending upon what time in the heart's development the narrowing takes place. Thus, when the stenosis occurs early, incomplete septum results. This was the condition in 64 of Peacock's 112 cases, and if the infection is later, a patent foramen ovale is the usual result.

When stenosis occurs shortly after birth, the increased blood-pressure in the right heart probably forces some blood into the left auricle, and thus has a tendency to prevent the closure of the foramen ovale. One may, therefore, be justified, from the condition of the foramen ovale, in deciding what time the infection took place, *i. e.*, as to whether it is congenital or not. Generally, when it is patent, the condition is considered congenital.

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* Malformation of Human Heart, third edition, 1866.

Hence, if with a pulmonary stenosis the foramen ovale is closed and the rest of the heart is normal, the stenosis must have developed some time after birth. If the infection leading to the stenosis developed during intra-uterine life or after birth is, of course, impossible to decide without clinical data.

On the other hand, it is not justifiable from the patent foramen ovale to conclude that the stenosis must have occurred immediately before or after birth, rather than later in life, since, in the first place, the foramen ovale is frequently patent in the healthy heart,* and, secondly, an increased pressure in the right auricle may lead to its reopening. There are, consequently, a number of cases of patent foramen ovale where it is impossible to determine whether the stenosis is congenital or acquired, and difference of opinion exists between writers, so that one describes as congenital what the other calls acquired.

The narrowing is nearly always due to a growing together and a thickening of the pulmonary valves, which are thus changed into a diaphragm, as a rule, smooth, having a triangular or round opening, the size of which controls the degree of stenosis. The diaphragm is, as a rule, cone shaped, with its apex pointing upward, or it may be saucer shaped, with the convex side toward the pulmonary artery, and on this surface there are often found three ridges indicating the union of the segments. Often the orifice is smaller than normal, and on the conus arteriosus are found irregular thickenings brought about by endocarditis. As far as the heart is concerned, the natural result of this resistance to the circulation will be a more or less pronounced hypertrophy, with or without dilatation—dilatation of the auricle often associated with hypertrophy and dilatation of the auriculoventricular orifice, with perhaps relative insufficiency of the tricuspid.

I desire to mention the one symptom characteristic of congenital heart lesions—the cyanosis. The extreme degree of this, with club-fingers and marked blueness of the skin and mucous membrane, is present only when there is a free communication between the right and the left heart, either in the septum or in a patent foramen ovale. Writers have put especial emphasis on the mixture of venous and arterial blood brought about through such a communication, and Speer† considers this the prime cause of the cyanosis.

B. Acquired Inflammation of the Pulmonary Orifice

The acquired diseases of the right heart are exceedingly rare—much more infrequent than the congenital. The literature, however, does contain a number of well-described cases—sufficiently large to give a picture of the diseases that occur here.

From a pathologic point of view the right conus arteriosus, the pul-

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* Ogle, Klob, and Wallmann in Henle, Handbuch der Gefässlehre, p. 9.

† Virchow's Jahresbericht, 1885, vol. iii, p. 200.

monary orifice with its semilunar valves, and the extrapulmonary part of the artery belong together, because this is the most frequent site of endocarditis on the right side, and they are rarely involved singly. Then too, they are more or less independent of the tricuspid. I do not wish to consider further the lesions of this valve, since its segments are seldom affected alone,* while it is frequently infected together with the mitral. The pathologic conditions of the right heart may then be arranged as follows:

I. Stenosis in the Conus Arteriosus Below the Pulmonary Valves

The first case of this type was described by Dittrich† under the title "Die wahre Herzstenose." He discovered this in a twenty-year-old, strongly built soldier, who for several years had suffered from valvular intermittence, and a year before he came under observation had been kicked on the sternum by a horse. Heart incompetence developed, and was followed by death. At the autopsy a white, firm fibrous ring, the lumen of which admitted only a small probe, was found in the conus arteriosus. Just above this ring was a bulging as large as a walnut, and above this the stiff, thick, and somewhat wrinkled pulmonary valves which were, nevertheless, competent. The pulmonary artery was unchanged. The right ventricle was but little dilated below the stenosis, while its walls were enormously hypertrophied.

A similar case has more recently been reported by C. Bernard.‡ This case occurred in a woman, fifty-six years old, who twenty years previously had suffered from acute articular rheumatism, whereupon incompetence gradually developed. There was found, 1 cm. below the healthy pulmonary segments, a fibrous ring, 2 to 3 cm. thick, admitting only the tip of the little finger. The pulmonary artery was dilated from the semilunar valves to its bifurcation. Both ventricles were hypertrophied, but especially the right, so that the walls of each were of nearly equal thickness. A similar case has been reported by Bennet.§ Dittrich considers trauma to have been the exciting factor in his case, and it is certainly plausible that a blow on the sternum should especially injure the right ventricle. On the other hand, it is very significant that in Bernard's case the same lesion is brought about through the most usual cause of endocarditis, namely, acute articular rheumatism.

II. Stenosis of the Pulmonary Valve

This occurs, as a rule, in two forms:

(*A*) The cusps are grown together along the adjoining edges. They are thickened, and consist of a diaphragm of white fibrous tissue perforated in a similar way to that in congenital stenosis.

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* Bamberger, Virchow's Handbuch der speciellen Pathol., und Therapie, 5. Abt. Bd. ii, p. 381.

† Prag. Vierteljahressch., 1849, vol. xxi, p. 159.

‡ Arch. Gen. de Med., 1856, ii, p. 161.

§ London Gazette, 1851.

The literature contains a rather large number of this type of cases. Bouillaud* collected four cases. Cruveilhier† pictures a heart with this form of stenosis, but, unfortunately, he gives no clinical facts. Philhouze‡ found a calcified diaphragm. Whitley§ found a white, fibrous diaphragm in the body of a woman, forty-four years old, who had been ill for ten months only, the symptoms appearing during pregnancy. Benedict|| recognized the disease during life in a woman of sixty who previously had suffered from rheumatism; Frerichs** recognized it in a man, thirty-four years old, with scoliosis, who had had symptoms from earliest youth. Mannkopff†† mentions a case in a man of twenty who had suffered from shortness of breath and cyanosis since seven; Speer refers to a case in a girl of seventeen who had been quite well until her thirteenth year; and With‡‡ describes a case in a man of twenty-five, with scoliosis, who had suffered for four years with a chest disease and died from pulmonary tuberculosis.

It has been impossible, in a number of these cases, to decide whether the condition was congenital or not. The difficulty consists in this, that the infection leading to stenosis usually sets in insidiously, so that a certain degree of stenosis is present before symptoms appear. The length of this latent period cannot be ascertained. Consequently the cases, in which the patients have suffered more or less from early childhood without having had an acute attack, must be supposed to have originated in intra-uterine life.

Only two of the cases also—Whitley's and Benedict's—can be said with certainty to be congenital.

(*B*) *Stenosis Due to Vegetations on the Pulmonary Segments.*—Whitley reports a case in a woman, thirty-eight years old, in whom symptoms developed after a blow on the chest. Two vegetations as large as walnuts were found on two segments, and a smaller one on the third. In another woman, found dying on the street, he found numerous vegetations on the free borders of the cusps. Then he mentions still another woman, thirty-six years of age, who thirteen years previous to her death had an attack of erysipelas; here he found the pulmonary orifice almost closed, and in addition there were numerous smaller excrescences around a pea-sized opening in the ventricular septum and also around the tricuspid valve. Finally, he observes that in a girl of thirteen who had pronounced symptoms of heart lesions since her third year the semilunar valves were almost worn away, and their place taken by a mass of vegetations which nearly clogged the opening. The cusps in the aorta were also covered with growths, whereas both the mitral and the tricuspid valves were unchanged, but the neighboring part of the pulmonary artery was rough and covered with coagula.

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[*] Traite clinique des maladies du cœur.

[†] Anat. path., 28 livr., pl. 4.

[‡] Mentioned by Cruveilhier.

[§] Guy's Hosp. Reports, 1857, iii, p. 252.

[||] Wien. med. Wochenschr., 1854, vol. iv, p. 547.

[**] *Ibid.*, 1853, vol. iii, p. 817.

[††] Ann. de Charité, 1863, vol. xi, p. 45.

[‡‡] Contribution to the Differential Diagnosis of Valvular Diseases of the Heart, Dissertation, Copenhagen, 1858.

III. Insufficiency of the Pulmonary Valve

This is less frequent than stenosis, and is caused as follows:

(*A*) *Ulcerative Endocarditis.*—Wahl,* reports a case in a woman of thirty-three who, for a month previous to her death, had suffered from an intermittent fever; half of one of the pulmonary cusps had been torn away, and the rest of the segments showed acute inflammatory changes, while the rest of the valves were perfectly healthy. This same type of lesion was observed by Whitley (*vide supra*) in a nineteen-year-old girl who had been sick only four months. In this case the pulmonary segments were worn away almost to their base, and the surrounding part of the pulmonary artery was eroded in spots and covered with coagula.

(*B*) *Chronic Endocarditis with Retraction of the Thickened Valves.*—In a twelve-year-old boy Gordon† found thick and shrunken pulmonary segments, through which a stream of water ran into the right ventricle. The foramen ovale was patent. Similar cases have been reported by Dietl,‡ Blachez,§ and Willigk.||

IV. Endarteritis in the Pulmonary Artery

In the part of this artery lying closest to the heart there occur both the ordinary endarteritis deformans and also infectious processes similar to those of the endocardium and the semilunar valves.

(*a*) In Whitley's case of insufficiency it concerned the ulcerative form.

(*b*) Here also belongs Willigk's case, in which numerous pedunculated vegetations were found on the anterior wall of the artery, and associated with them greatly thickened and wrinkled pulmonary segments and growths on the semilunar valves of the aorta.

(*c*) Stenosis of the artery itself has been described by Eriksen.**

The patient in this case was a thirty-eight-year-old woman who had been perfectly well until she died of a double pneumonia at the same time as there were signs of hypertrophy of the heart and a murmur with the first sound. He found a ring-shaped stricture 1 cm. above the unchanged pulmonary valves. From this ring arching ridges radiated toward the bifurcation, which was somewhat constricted. Between these ridges the arterial wall was thrown into pouches. The anterior cusp of the tricuspid was somewhat thick and retracted.

(*d*) Stenosis of the pulmonary branches has been observed in case of the right artery only. Willigk (*vide supra*) reports finding the right pulmonary narrowed to a diameter of 2 mm. near the right bronchus; the patient was a man, forty-nine years old, who died from tuberculosis of the lungs. At its origin the diameter of the branch was 16 mm. To the right of the bronchus the artery again assumed its normal width. The arterial wall was thick, very hard, and contained a few white spots.

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* Petersburger Zeitschr., 1861, vol. i, p. 359.

† Stokes-Lindwurm, Der Krankheiten des Herzens und der Aorta, Würzburg, 1855.

‡ Wien. med. Wochenschr., 1854, vol. iv.

§ Gaz. d. Hôp., 1866.

|| Prag. Vierteljahressch., 1853, p. 21.

** Petersburger Zeitschr., 1861, vol. i, p. 89.

which often are rough and angular, or covered with sharp points, as is the case with oxalate of calcium stones.

Occasionally hydronephrosis results from a defective development of one of the ureters, which is patent to a certain point in its course only, a solid string of connective tissue extending from this point to the bladder. The obstruction may not occur in the lumen of the canal only. Frequently the ureter is compressed from without by tumors, as, for instance, cancer of the uterus and its adnexa, ovarian cysts, cancer of the pelvis, or abscesses in this region and the lower part of the abdomen. One of the most frequent of the latter, namely, phlegmon in the connective tissue around the cecum and the lower part of the ascending colon is likely, on account of the anatomic conditions, to compress the right ureter, which runs in the connective tissue behind the bowel. Further, disturbances in the position of the neighboring organs, as, for instance, prolapse of the uterus, may place the ureter in such a position that it is difficult for the urine to pass through. Curiously enough, occasional instances of hydronephrosis have been found in which the ureter was patent and occupied its usual position, not being exposed to pressure from without. We owe to Virchow* the explanation of this peculiar condition. He found in all instances of this kind which he had opportunity to examine that the obstruction depended upon a valve formed by a fold of the wall of the ureter, and blocking the passage in the same way as the semilunar valves in veins. He believes that the valve or fold is formed on account of the oblique emergence of the ureter from the pelvis; consequently he must have found that in all cases the valve was situated just at the entrance into the ureter. I have not had opportunity to observe any instance of this kind.

3. Partial or Local Hydronephrosis.—In this form only a part of the kidney is the seat of dilatation, the remainder being normal. It is found extremely rarely, and is dependent upon one of two conditions. Either the kidney has double ureters, one being impervious, or there is an obstruction above the ureter.

With respect to double ureter, let me recall briefly the anatomic conditions. Normally, we find that the ureter is a cylindric muscular canal, 1 to 3 mm. wide when filled, and extending from the trigonum Lieutaudii of the bladder to the hilus of the kidney, where it dilates very rapidly, or more gradually to a short canal, 15 mm. wide—the so-called renal pelvis. This divides into two short canals 10 mm. wide, one for the upper and one for the lower part of the kidney. These two principal branches, which are subject to some variation with respect to length and to lumen, divide again, giving off branches to the sides of the individual renal calices. When the two principal branches, instead of uniting in the hilus and of emptying into the pelvis, continue separately for a shorter or a longer distance toward the bladder, or, which is more frequent, empty, each by itself, into the bladder, then we have two ureters, one for each part of the kidney. In this case there is no renal pelvis in the usual meaning of the word, but rather two such pelves. This anomaly is not extremely rare: I have seen it twice in 500 bodies. In both cases the ureter from the upper half of the kidney entered the bladder about 1 cm. below and to the inside of the opening of the ureter from the lower half, which was situated at the usual point in the upper corner of the trigone. This, however, is not always the case, as one of the two ureters has been found to enter the bladder in the middle of the posterior wall.

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* Die krankhaften Geschwülste, vol. i, p. 268.

It is to be expected that, in the same proportion as double ureters are less frequent than single, so also partial hydronephrosis dependent on occlusion or defective development of one of the ureters must be less frequent than the total.

An instance of partial hydronephrosis in a kidney with double ureters, of which one was defectively developed, is described by Heller.* In the body of a woman, seventy-nine years old, who was supposed to have a large ovarian cyst, and who died of croupous pneumonia, he found a large sac with thin walls which filled nearly the whole abdomen, and contained 3400 c.c. of a light brown, somewhat turbid, watery fluid, in which were albumin, urates, and urea. From the lowest part of the sac extended a tortuous dilated ureter, which terminated blindly at the lower part of the bladder, just behind the point where the ureter arises. On the anterior surface of the lower part of the sac, near the cecum, was found the lower half of the right kidney, somewhat flattened, with a slightly dilated pelvis from which arose a ureter which opened in the urinary bladder at the usual point. The left kidney was of usual size, but it also had two ureters which united immediately before their entrance into the bladder. Although there was no history in this case, so that it was impossible to learn how long the tumor had existed, Heller believes that in the absence of indications of inflammation in the region of the closed ureter the occlusion and hydronephrosis in this case were of fetal origin.

Heller† has also observed a case in which one of the two ureters had been closed by a stricture following a lesion caused by the passage of a stone. This occurred in an insane man, sixty-nine years old, who died of pulmonary gangrene; the upper half of the right kidney was changed into a sac as large as a fist, and filled with a clear serous fluid. On the inside was a layer of renal tissue 4 mm. in thickness, the sac passing downward into a finger-like projection from the end of which a solid string of connective tissue, about 1 cm. long, passed to the upper end of the open ureter, in the lower end of which was an oval calculus as large as a pea. The lower half of the kidney was normal in appearance, and provided with its own ureter, which was patent. The left kidney was healthy and had only one ureter.

The literature contains as yet only one case of local hydronephrosis with double ureter. This was observed by Valter (quoted by Heller) in a man thirty years old, in whom there were double ureters on both sides, the upper half of the right kidney being changed into a fairly large sac, the corresponding ureter being dilated. How the obstruction arose in this case is unknown.

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* Deut. Arch. f. klin. Med., 1869, vol. v, p. 267.

† *Ibid.*, 1870, vol. vi, p. 276.

If there are no double ureters, then a partial hydronephrosis may arise as the result of an occlusion of a part of the pelvis or of a single calyx; that is to say, the obstruction may lie above the ureters. As the pelvis and calices are comparatively wide canals, obstruction to the passage of urine through them is extremely rare.

So far as I know, there is only one case described in which a single calyx was occluded (Rayer), while an obstruction in the renal pelvis itself does not seem to be mentioned in the literature at all.

In his large atlas Rayer depicts a kidney (Pl. XXV, Figs. 1, 2, 3, 4) at the lower part of which there is a thin-walled sac as large as a hen's egg, which communicates with the pelvis by a very minute opening. How the narrowing arose in this case he does not mention.

An instance of partial hydronephrosis in which the obstruction was situated in the pelvis itself was observed in the hospital here, and as it is of interest not only on account of its rarity, but also for other reasons, I shall describe it thoroughly:

Edvard Knudsen, twenty years old, carpenter's apprentice, came of a healthy family, and was always well until the summer of 1872, when there appeared severe pains in the abdomen, in the region of the umbilicus, and diarrhea which ceased after some time, while the pains continued, although lessened in severity. One or two months later there was noted a fluctuating tumor in the region of the right kidney, as large as an orange, and situated immediately below the right lobe of the liver.

For some time the patient was under the care of a homeopath, and when he again came under medical treatment, the swelling had disappeared, while the pain continued and was especially marked when he walked about, and at this time the right lower extremity became flexed toward the trunk, and efforts to change this position caused pain. In the course of the next two weeks the swelling in the region of the kidney began and increased steadily in size. At the same time there appeared a swelling under the right Poupart's ligament, and a little later a swelling appeared also in the region of the right great trochanter, between this and the anterior superior iliac spine. The appetite diminished, the patient became much emaciated, and on the sixteenth of December he was admitted to the surgical department of the Kommunehospital—chief surgeon, Dr. Holmer, to whom I am grateful for permission to use the record.

The patient was extremely emaciated, somewhat febrile, tongue dry, pulse 96. There was slight dullness over the right apex. The entire right half of the abdomen was the seat of a swelling which was dull on percussion, and which clearly consisted of two well-separated parts, an upper and a lower. The upper part formed a rough, somewhat superficial, fluctuating swelling, which was limited above by the right lobe of the liver; on the left, by the linea alba, so far down as the umbilicus, the lower border extending from this point downward and outward to the crest of the ilium, the lower part being separated by a distinct, although not very deep, furrow. The lower part filled the entire right iliac fossa. It was fluctuating, and had no distinct communication with the upper part, but communicated with fluctuating swellings in the trigonum subinguinale, about the trochanter major, and on the posterior surface of the thigh. The thigh was strongly flexed at the hip, and passive movements were very painful. There were no changes in connection with the spinal column. Changes of position by the patient did not result in any changes in the swellings.

Dr. Holmer punctured the upper part with Dieulafoy's syringe from behind, and evacuated 2000 c.c. of a thin, light yellow, clear fluid.

Chemic analysis of this fluid in the physiologic laboratory of the University by Dr. Buntzen gave the following result:

The fluid was light yellow and clear, becoming slightly opaque on standing for some time. There were no organic elements to be seen under the microscope. Specific gravity was 1007; reaction, neutral. There was a very insignificant quantity of albumin—too small to be determined. The fluid caused no change of polarized light. No sugar. Urea was present in large quantities, and was demonstrated under the microscope as crystals of nitrate and oxalate of urea. Uric acid was not demonstrable. There were present alkaline chlorids and phosphates in large quantities, and only traces of sulphates.

After the puncture the larger swelling collapsed entirely, and the abdomen became soft and natural and gave a clear percussion-note. The tumors of the iliac fossa and the thigh, on the other hand, continued unchanged. Five days later puncture in the iliac fossa gave exit to 500 c.c. of foul-smelling pus, and incision in the thigh also gave exit to pus of the same kind. In the course of the following days the patient failed more and more, and died January 1, 1873. The diagnosis was assumed to be right hydronephrosis, abscess in the right iliac fossa, congestion abscess in the right thigh.

The postmortem, which I made forty-eight hours after death, showed the following things:

The body is greatly emaciated. Only slight rigor. In the upper part of the right thigh are incisions through which a small amount of grayish pus is running out. Heart is normal. In both lungs are a number of small infarcts, recent and old, and a few small abscesses near the surface. No fluid in the peritoneal cavity, the lining of which is everywhere smooth. In the right side is a round, flat, fluctuating swelling, 16 cm. long and 14 cm. across, which occupies the lumbar region below the liver, as well as the upper half of the iliac fossa. The entire surface is covered by peritoneum, over which run the transverse colon and a part of the duodenum. Posteriorly, the swelling is adherent to the right kidney, and inseparably connected with it. Behind the peritoneum, below the cecum, is an abscess cavity filled with a cheesy material, from which leads an extension into the right internal iliac muscle, forming an abscess occupying the whole iliac fossa, and extending along the tendon of the iliopsoas down to the trochanter minor, and then between the quadratus femoris and the adductor magnus muscles over to the posterior surface of the thigh, and then downward for a distance along the sciatic nerve. The liver is normal. The spleen is somewhat large and friable. The intestinal canal is everywhere normal, except in the lower 7 cm. of the ileum and the beginning of the cecum, in which the mucous membrane is somewhat pigmented, irregular, and thick, with polypoid outgrowths from the size of a hempseed to that of a pea. The left kidney and its ureter are normal. The bladder contains a small amount of clear urine, and its lining is normal. The right ureter extends through the perityphlitic abscess, being somewhat narrowed at this point, but permits the passage of an ordinary sound. By pressure on the kidney urine flows without difficulty through the ureter, but there is no flow of any kind when pressure is made upon the large fluctuating cyst. The ureter is somewhat dilated above the abscess. The pelvis is dilated, forming a sac as large as a hen's egg, and is seen to belong to the lower two-thirds of the kidney, the tissue of which is lightly compressed, the papillæ being somewhat flattened, the pyramids a little broader and shorter than usual, while the cortical substance is of normal thickness. In the cortex are two small infarcts; otherwise the tissue is healthy.

The upper third of the kidney is absent, the place being occupied by the large swelling which is a thin-walled unilocular sac as large as a child's head, and contains 750 c.c. of a light yellow, clear fluid. On the posterior wall is seen the puncture made during life. The part of the sac adjacent to the kidney communicates with the pelvis through a round opening 1 cm. in diameter. This opening is covered by a valve which is 5 cm. wide and 1½ cm. high, which hangs over the opening like an eyelid, and occludes it when the sac is filled with fluid, whereas fluid easily enters the sac from the pelvis, as the movable valve easily opens itself. The valve is semilunar, and is formed by the remains of the wall between two calices. Similar half-moon-shaped trabeculæ are found everywhere in the sac, the walls of which form flattened dilatations varying in size from a walnut to a hen's

egg, the single calices, each one of which is related to two or three of these valves or trabeculæ. The inner surface of the sac is smooth, being covered here and there by a layer of clear mucus; the wall is composed of two layers—an inner, ½ to 1 mm. thick, grayish and soft, and an outer 2 to 3 mm. thick, white, glistening, firm. The inner layer is formed by atrophic renal tissue, the microscope showing villi surrounded by fine connective tissue,

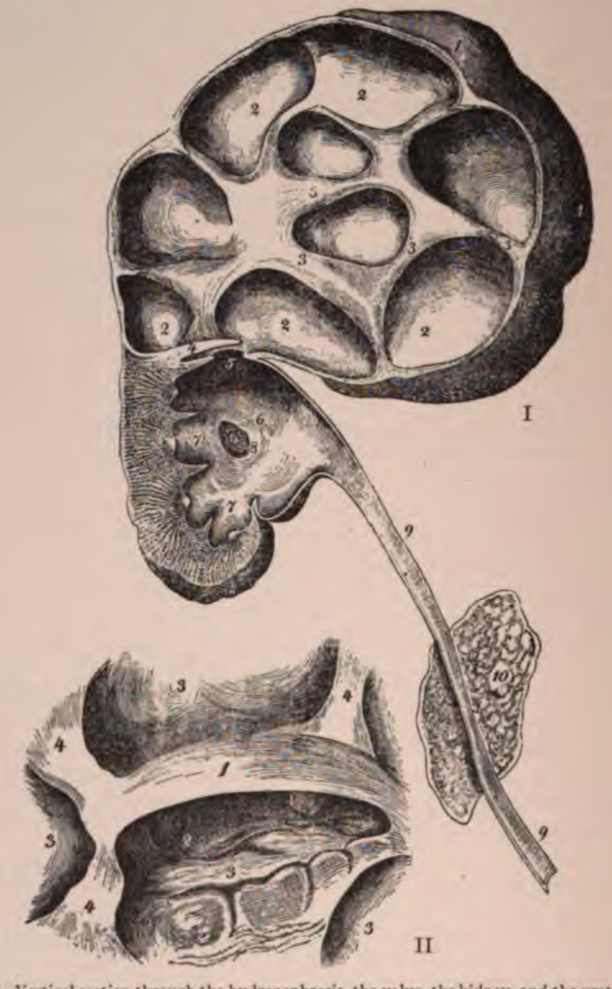

Fig. 8.—I, Vertical section through the hydronephrosis, the valve, the kidney, and the ureter (half natural size): 1, The hydronephrotic sac; 2, dilatations corresponding to the individual calices; they are surrounded by 3, the semilunar partitions, of which the lower forms 4, the valve, which covers 5, the opening to the rest of the somewhat dilated pelvis, 6; 7, calices; 8, the calyx seen from its entrance to the pelvis; 9, the ureter, which is somewhat narrowed in its course through 10, the perityphlitic abscess. II, The bottom of the sac with the opening into the pelvis of the kidney and the valve, seen from above (natural size): 1, The valve, which is lifted up somewhat; 2, the opening; 3, the calices; 4, partitions.

but without any distinct renal epithelial cells. Here and there is seen a single glomerulus. The outer layer is a solid fibrillar connective tissue, poorly provided with nuclei and vessels. The diagnosis consequently was perityphlitis cæci, abscessus fossæ iliacæ et femoris dextri, hydronephrosis localis renis dextri.

Here, then, we find an obstruction in the center of the pelvis of the kidney, in the form of a narrow opening which is closed by a movable valve, and the question arises how this obstruction developed. The answer is closely connected with the development of hydronephrosis in general, and on this account I wish briefly to discuss it.

Dilatation of the kidney takes place in the following way: The renal pelvis dilates uniformly and retains in general its original form, the walls being, however, a little more rounded, while the calices change their shape considerably, as the renal tissue first yields to the pressure, so that the papillæ of the pyramids first become flat, later somewhat concave, while the mucous membrane and fibrous tissue around the papillæ do not yield very much. Consequently the calices at first become ball shaped, and appear like a cluster of grapes, with thick stems, about the pelvis. As the pyramids yield to the pressure, while the intervening columns of Bertini persist longer, the single cavities, corresponding each to a pyramid, remain separated by partitions which are never absent, even when the dilatation has reached the highest degree, and which are recognized as semilunar valves with sharp margins surrounding the individual dilatations. These folds or partitions vary very much in width, which depends upon the different depth and size of the single calices, and in the case in hand a fold of this sort was sufficiently broad to cover over the opening below it.

But why did we find in this case this relatively narrow opening between the sac and the dilated pelvis below? We found that the entrance to the calices is dilated less than their floor and walls. It lies near at hand to assume that the same may be the case at the entrances from the pelvis to the principal branches. It is exceedingly probable that the two principal branches in this case have behaved in such a way that the upper furnished the calices of the cyst, and the lower the calices of the lower two-thirds of the kidney, and that the origin of the upper branch is the opening covered by the valve.

The development of the hydronephrosis may be sketched as follows: The primary lesion is inflammation about the cecum. From the history we observe that the attacks of pain in the abdomen were older than the origin of the swelling, as there had been perityphlitis and diarrhea two months before swelling was noticed. From the very beginning of the perityphlitis the right ureter became compressed more or less, thus causing a moderate degree of dilatation of the pelvis and of both principal branches. At this time the wall between the first and second calyx of the upper branch, the valve that formed later, commenced to close the angle of division. This is not so remarkable when one considers the variations in form and size observed in the single calices, as well as the movability between the single parts of other soft organs lying in the abdominal cavity, together with the movable intestines. If at first only a temporary closure was effected, then conditions are present for a greater dilatation, and the valve, by falling down over the opening, would protect this against pressure which otherwise would dilate it. In favor of the view that closure by the valve in the beginning of the development of the

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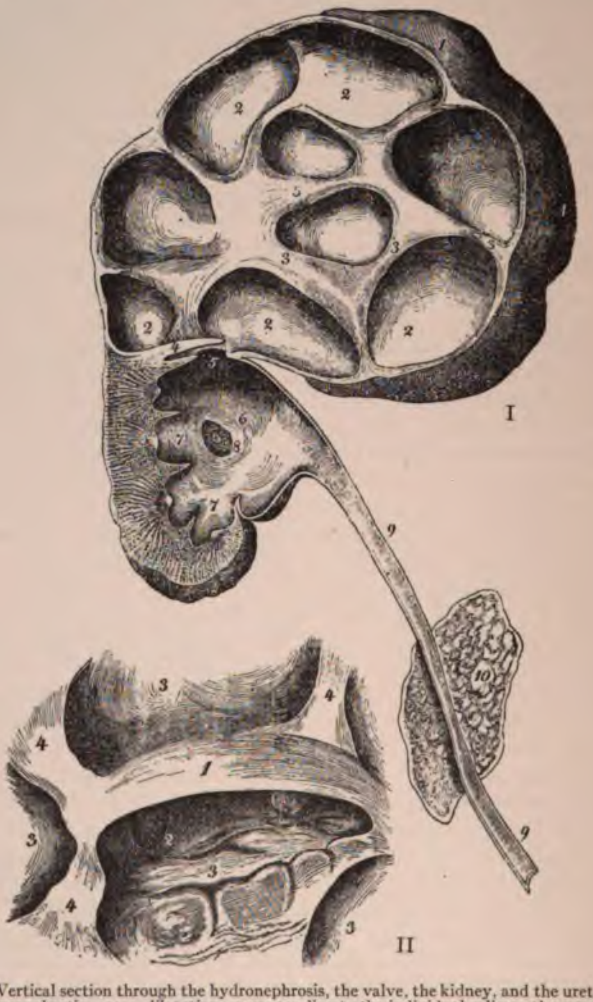

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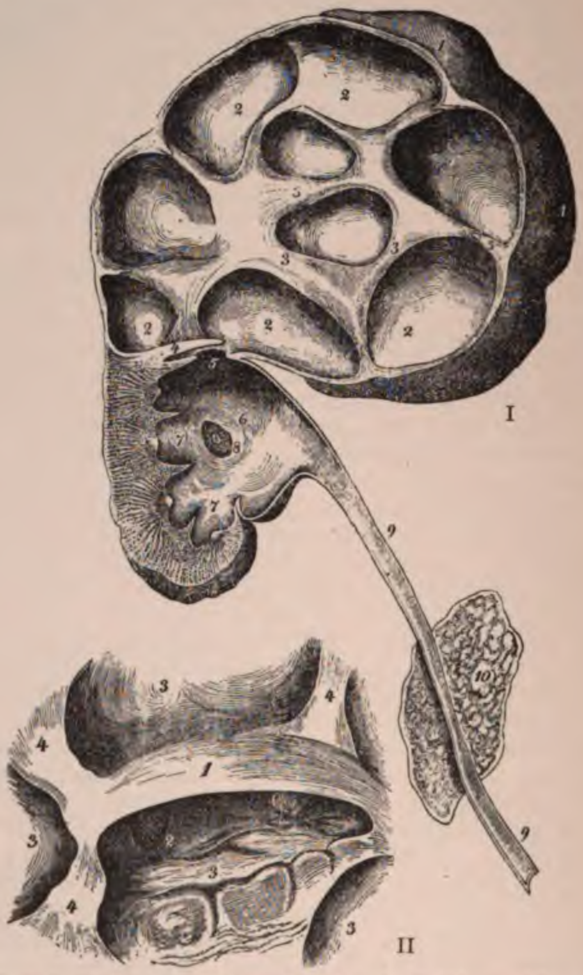

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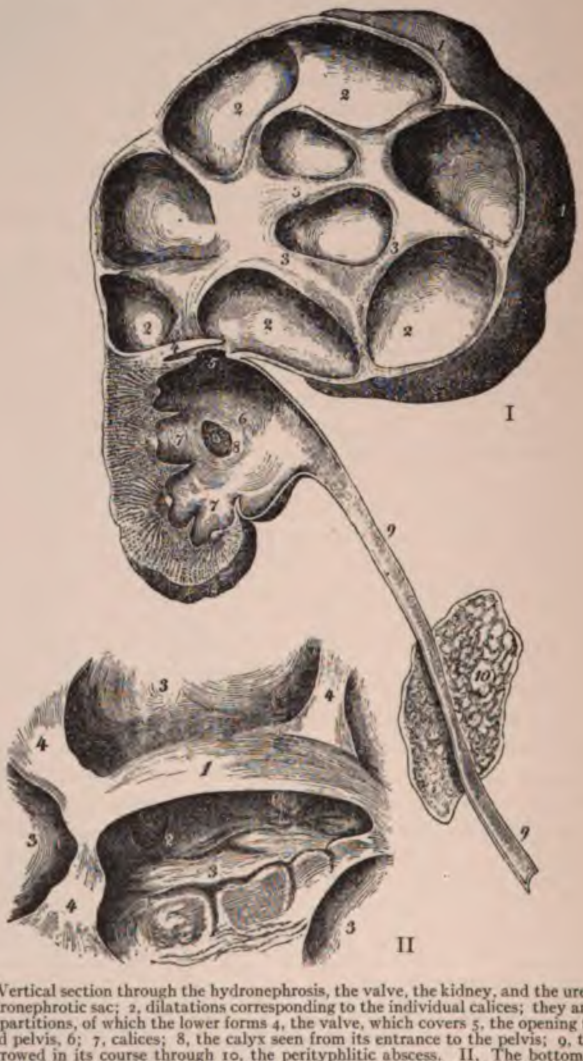

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egg, the single calices, each one of which is related to two or three of these valves or trabeculæ. The inner surface of the sac is smooth, being covered here and there by a layer of clear mucus; the wall is composed of two layers—an inner, ½ to 1 mm. thick, grayish and soft, and an outer 2 to 3 mm. thick, white, glistening, firm. The inner layer is formed by atrophic renal tissue, the microscope showing villi surrounded by fine connective tissue, but without any distinct renal epithelial cells. Here and there is seen a single glomerulus. The outer layer is a solid fibrillar connective tissue, poorly provided with nuclei and vessels. The diagnosis consequently was perityphlitis cæci, abscessus fossæ iliacæ et femoris dextri, hydronephrosis localis renis dextri.

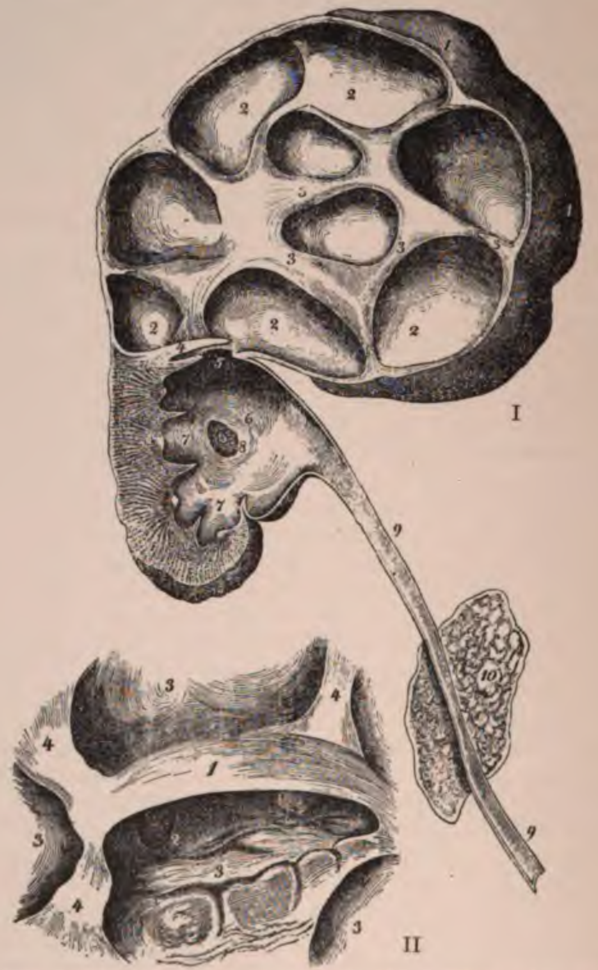

Fig. 8.—I, Vertical section through the hydronephrosis, the valve, the kidney, and the ureter (half natural size): 1, The hydronephrotic sac; 2, dilatations corresponding to the individual calices; they are surrounded by 3, the semilunar partitions, of which the lower forms 4, the valve, which covers 5, the opening to the rest of the somewhat dilated pelvis, 6; 7, calices; 8, the calyx seen from its entrance to the pelvis; 9, the ureter, which is somewhat narrowed in its course through 10, the perityphlitic abscess. II, The bottom of the sac with the opening into the pelvis of the kidney and the valve, seen from above (natural size): 1, The valve, which is lifted up somewhat; 2, the opening; 3, the calices; 4, partitions.

Here, then, we find an obstruction in the center of the pelvis of the kidney, in the form of a narrow opening which is closed by a movable valve, and the question arises how this obstruction developed. The answer is closely connected with the development of hydronephrosis in general, and on this account I wish briefly to discuss it.

Dilatation of the kidney takes place in the following way: The renal pelvis dilates uniformly and retains in general its original form, the walls being, however, a little more rounded, while the calices change their shape considerably, as the renal tissue first yields to the pressure, so that the papillæ of the pyramids first become flat, later somewhat concave, while the mucous membrane and fibrous tissue around the papillæ do not yield very much. Consequently the calices at first become ball shaped, and appear like a cluster of grapes, with thick stems, about the pelvis. As the pyramids yield to the pressure, while the intervening columns of Bertini persist longer, the single cavities, corresponding each to a pyramid, remain separated by partitions which are never absent, even when the dilatation has reached the highest degree, and which are recognized as semilunar valves with sharp margins surrounding the individual dilatations. These folds or partitions vary very much in width, which depends upon the different depth and size of the single calices, and in the case in hand a fold of this sort was sufficiently broad to cover over the opening below it.

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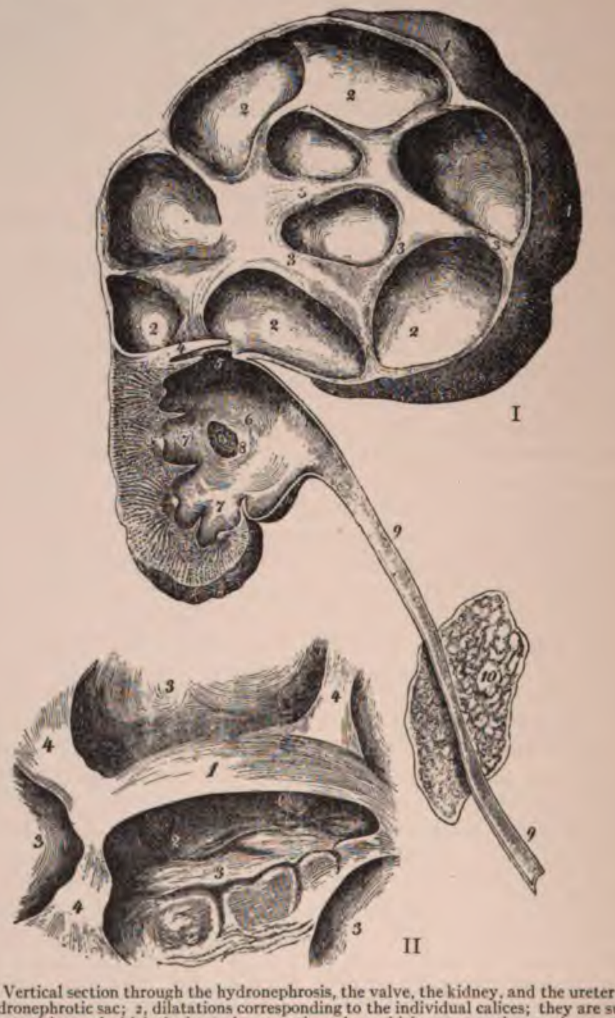

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hydronephrosis would give way, we have the fact that the swelling in the fall of 1872, when it had reached the size of an orange, disappeared, to reappear again somewhat later and increase in size. At this time it would seem that, through some movement of the kidney, the valve failed to close the opening, and the urine was allowed to evacuate itself. Whether an evacuation of this sort took place at other times, and whether there at the same time was a sudden increase in the amount of urine passed, we do not know, because the patient now lived at home and was not subject to the close and regular observation which is possible only in a hospital.

In addition to this peculiar and interesting development of an obstruction in the pelvis of the kidney I wish to emphasize also another point in this case which is of no less interest.

Information is given as to the time which is necessary for a hydronephrosis of this sort to develop. Outside of the few cases of hydronephrosis in new-born children, in which the period of fetal life was sufficient for the development, but in which the dilatation was not very considerable (Moreau, Rayer) and did not lead to complete atrophy of the kidney tissue, and confining the attention to the cases of hydronephrosis described in adults, we find that the swelling always existed for several years, being often stationary for years, and the impression results that the development proceeds very slowly. It is consequently noteworthy that in this case the hydronephrosis could be followed in its development, and it is remarkable that, in the course of half a year, it could reach a swelling as large as a child's head, and with the same complete atrophy of the renal tissue and the same increased thickness of the capsule which are found in instances several years old.

ON CANCER OF THE STOMACH WITH SPECIAL REFERENCE TO ITS STRUCTURE, DEVELOPMENT, AND EXTENSION*

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PREFACE

IT is the purpose of this dissertation, the material for which I have gathered, for the most part, in the postmortem room of the Kommunehospital, to treat of cancer of the stomach from a pathologico-anatomic point of view exclusively. An equally extensive consideration of this subject from all points of view would require a much greater material than that which has been at my disposal. Consequently, I have omitted or considered but briefly certain aspects upon which the material at hand did not throw any light, and especially those aspects which require for elucidation statistics, as, for instance, the influence of sex, age, etc. On the other hand, I have been able to conduct more thorough investigations especially with regard to the structure and development of the individual forms of cancer of the stomach and of its extension into neighboring organs. On account of pecuniary reasons I have been compelled to use only a very small number of the illustrations prepared in the course of this investigation. In order to save space I have included only the essential points in the postmortem reports of each case, and only a few reports are printed in full, mostly as examples.

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* Thesis accepted by the faculty of the University of Copenhagen for the Degree of Doctor of Medicine, 1874. (Translated from the Danish by Dr. D. J. Glomset.)

The advice and suggestions of Professor Dr. med. Reisz have been of great assistance to me during the course of this work, and I ask him to accept my thanks not only for his help, but also for his constant good-will.

HISTORIC INTRODUCTION

Without doubt cancer of the stomach existed in the earliest historic times as a common ailment of man. That a disease of such a sad and serious nature early attracted the attention of physicians is easily understood. But since the tumor existed in an organ not accessible from the exterior, recognition was impossible during older times, when autopsies were either utterly unknown or so rare that normal anatomy only could profit from them. Hence Hippocrates knew nothing of cancer of the stomach. It is, therefore, not strictly correct to assume with Rènè Prus* that Hippocrates† describes cancer of the stomach under "*μελαινα*." To be sure, a number of the cases described under this term must have had cancer because of the symptoms, viz., weakness, emaciation, and vomiting of food and bile, and sometimes of a black fluid, often associated with a feeling of weight in the abdomen, but these symptoms are also the symptoms of other chronic troubles in the stomach, as ulcer, chronic catarrh, etc., and the one typical sign of cancer of the stomach—a palpable tumor in the cardiac or epigastric regions—was unknown to Hippocrates.

Cancer of the stomach was apparently recognized by Galen,‡ for he writes that a "tuberculum carnosum" might prevent food from passing through the pylorus and thereby give rise to nausea and vomiting. He does not, however, consider this tumor a malignant growth, since in his volume on Organic Diseases,§ under "de tumoribus praeter naturam," he fails to mention the stomach. Neither does he connect it with melena, the cause of which both he and Hippocrates see in black bile (atrabilis). Consequently neither Hippocrates nor Galen had any definite ideas of cancer of the stomach.

The Arabian physicians‖ mention outgrowths in the stomach, but they evidently obtained their knowledge from the Greeks, and not from dissections, since their religion forbade any mutilation of the dead.**

In the long period from Galen (131–201 A. D.) to the sixteenth century practically no progress was made. But in the sixteenth century autopsies became more common. Yet the interest, of course, centered around normal anatomy, and it is in the year-books of anatomy that the names of the great men of that day, as Vesalius (1543), Fallopia, Eustacchio, etc., are found. This closer study of anatomy led to the finding of pathologic changes, and these in turn stimulated to research in pathologic anatomy.

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* Recherch. nouv. sur la nature et traitément du cancer de l'estomac, Paris, 1828.

† Hippocrates: De morbis, edit. E. Littré, 1861, viii, pp. 111, 113, 115. *Περὶ νουσων.*

‡ Galeni: Opera, edit. Kuhn, vol. vii, p. 218.

§ *Loc. cit.*, vol. viii, p. 705.

‖ Rènè Prus, p. 3. Morgagni: De sediles et causis morborum, 1761, Epist. xxix, 17.

** Förster: Handbuch der pathol., Anat., 1865, vol. i, p. 24.

In the seventeenth century clinical histories, accompanied with autopsy records, appear both in systematic handbooks and in monographs on individual diseases. But the symptomatic conception of diseases still predominated, so that the pathologic observations associated with the symptoms were not used as a foundation for the classification of diseases—at any rate, not to the extent they should have been used and were used in the eighteenth century.

Among writers of the seventeenth century I wish to mention only our famous countryman, Thomas Bartholin, because Plauquet* and Frank† mention him as having made the earliest or one of the earliest observations on cancer of the stomach. This, however, is not strictly correct, for both Plauquet and Frank refer to one of Bartholin's histories, "Tophi in Animalium Ventriculus."‡ But in this Bartholin simply describes the well-known spheric conglomerations of hair found in the stomach of horses, cattle, and sheep. These, of course, have absolutely no relation to cancer of the stomach.

During the eighteenth century the anatomic investigations began to affect the theoretic classification of disease according to symptoms. The famous work of Morgagni, "De sedibus et causis morborum per anatomen indagatis," is the foundation of pathologic anatomy, and its importance for the recognition and understanding of diseases.

In epistles XXIX and XXX of this work is found a complete and well-written clinical record of carcinoma of the stomach, accompanied by full pathologic descriptions, the pathologic data having been obtained partly by Morgagni and partly by his great teacher, Valsalva. Morgagni describes both the scirrhous (Ventriculus erat in pylore callosus) and the softer forms.

Numerous clear descriptions of carcinoma of the stomach and of its accompanying symptom-complex were produced during this century, both in systematic text-books and in monographs dealing with diseases of the abdomen and of the stomach. Cancer is designated as scirrhus, steatoma, tumor, ulcus, ulcus cancrosum, and the like. In the journals are found reports of observations on cancer made by Danish writers. Thus Sibbern§ describes a case in which the stomach had contracted to such a degree that it barely held half an ounce of fluid. Berger|| mentions a scirrhous stenosis of the pylorus, and F. L. Bang** reports the

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* Litteratura medica, 1809, vol. iv, p. 308.

† Praxis medica, 1835, vol. i, p. 652.

‡ Historiar. Anat. rar. Cent. II, Hist. XXI.

§ Einige anatomische Beobachtungen in Med.-Chir. Bibliothek, von Joh. Clem Tode, 1776, vol. iii, p. 193.

|| Acta. Soc. med. Hauniensis, 1777, vol. i, p. 61.

** Acta. Soc. med. Hauniensis, vol. i, p. 274; vol. iii, p. 87.

case of a man, sixty years old, who had suffered from gastralgia, vomiting, etc., for over half a year; palpation revealed a tumor the size of a fist over the cardia; the autopsy showed a cartilaginous tumor as large as a child's head in the right half of the stomach. He also mentions the case of a man, thirty-two years of age, who suffered from gastralgia and vomiting for two years. Postmortem examination showed the pylorus reduced to a cartilaginous mass as thick as a finger. At this time the disease was neither diagnosed nor recognized as cancer. Anything like a knowledge of the origin, structure, and development was impossible at that stage of the science of anatomy. However, the conception of minor pathologic differences was developed to such an extent that Baillie,[*] who wrote the first systematic anatomy in 1793, distinguished between round ulcer and cancer.

The next advance was made possible by Bichat,[†] who created general anatomy, the doctrine concerning the individual tissues of which the organs are made up. By this a new field of investigation was opened also with respect to carcinoma of the stomach. It became necessary to investigate in which of the tissues of the stomach cancer develops, of what tissue it consisted, and how these tissues were related to its surroundings.

Up to about 1840 the knife was used more than the microscope for examination of tissues. In one of the most famous monographs from this time Rènè Prus[‡] gives accurate measurements of the increased thickness of the various layers, serosa, muscularis, etc.

It was observed that the various layers became inseparable, and the frequently considerable increase in thickness of the muscularis and the submucosa led to the belief that these were the source of the cancer (Prus, Baillie). Increased thickness of the mucosa with pigmentation was also noted (Dejaer, Prus), and even thickening of the vagus was seen in the region of the cardia in some cases (Cruveilhier, Prus).

The microscope was seldom used to study the structure of the carcinoma. The observers were usually satisfied to record what they could see with the naked eye. The principal varieties of cancer known at this time was the scirrhous, the encephaloid (Laennec[§]), and the colloid carcinoma (Otto[||]). The numerous subvarieties of these grew out of external differences of color, consistence, and similarities to organs and even plants. Thus under encephaloid cancer the following varieties were described: Fungus hematoides (Hey), called so because of its abundant blood-supply, mastoid or mammary sarcoma (Abernethy), spleen-like tumor of the mucous membrane (Monroe), nephroid tumor (Recamier), etc. The former varieties of scirrhous carcinoma were described as chondroid and nephroid, solanoid (like a bisected potato), napiform (like a cut turnip), "pancreatic sarcoma" (Abernethy), etc.

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[*] Morbid Anatomy of Some of the Most Important Parts of Human Body, London. 1793, p. 87.

[†] Anat. gen., Paris, 1801.

[‡] Recherches nouvelles la nature et le traitement de cancer de l'estomac, Paris, 1828.

[§] Traité d'Auscultation mediate, 1837, vol. ii, p. 352.

[||] Seltene Beobachtungen zur Anat., Physiol., und Pathol., Breslau, 1816.

The theories held regarding the development of carcinoma were not based on anatomic observations. Laennec considered cancer to be made up of a substance foreign to the body, and existing as a parasite which lived a more or less independent life, consisting of two stages—the crude stage and the stage of softening. Chardel* held that the lymph escaped into the wall of the stomach and formed carcinomatous growths. Broussais,† who originated the antiphlogistic treatment, looked upon cancer as a subinflammation of the lymph-vessels, the exciting cause of which was in the nervous system and in the blood-vessels—in the nerves in so far as they act on the blood-vessels, and in the blood-vessels because they are the seat of the inflammation which always precedes and causes the cancer. When chronic gastritis was not treated right, scirrhous carcinoma developed, because the time of the year, the climate, and the individual's constitution predispose to this, and persons with lymphatic temperament, in whom the lymph-vessels are irritable, are most predisposed to carcinoma. As soon as scirrhous carcinoma developed, the tissues became destroyed and the disease incurable. He also gives a fairly good account of the symptoms and the diagnosis, and emphasizes the palpable tumor present in cancer of the fundus and pylorus, but not of the cardia.

Benech‡ believes that chronic catarrh of the stomach often leads to cancer, but emphasizes that hereditary predisposition plays an important part.

The great difficulty of recognizing cancer of the stomach at that time was felt by Prus, who believed that neither the scirrhous nor the encephaloid form had a distinct structure, not being different from that found in "tumor albus" at the joints. He believed that both the blood-vessels and the lymphatics played a part in the development of cancer, but that the tissues themselves are changed to carcinoma.

Andral§ failed to find any special difference between the scirrhous tumors of the stomach and the thickened mucosa of chronic inflammation of the rectum in chronic diarrhea. He, therefore, considered this type of carcinoma as a benign hypertrophy. He does, however, give a good description of the symptoms.

Cruveilhier‖ first believed that carcinoma originated in the connective tissue, but in his great atlas (1832–40) he gives excellent observations and pictures of the three types of cancer of the stomach—scirrhous, medullary, and alveolar. He has changed his views about the origin of the tumors, which he traced to the venous capillaries, since he had observed masses of cancerous tissue extending into the large veins. His ideas were not based on microscopic observation, hence are merely hypothetic.

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* Monographie des degenerat. squirrheuses de l'estomac, Paris, 1804.

† Phlegmasies chroniques, 1822, p. 22.

‡ Traité des cancers de l'estomac, Paris, 1829.

§ Precis d'anat. pathologique, Paris, 1829.

‖ Nouvelle Bibliotheque medicale, 1827.

Hope* was the first to suggest that a majority of cancers originate in the mucosa, and usually extend down into the submucosa; others originate here. The effect of the cancer is often only a simple hypertrophy of the mucosa; at other times soft cancerous tumors form.

Two cases of scirrhous cancer of the stomach are given by Abercrombie,† with a fairly good description of the symptoms.

Frank wrote a description of carcinoma of the stomach from the cases given in the literature up to his time, but he does not cite any new cases or observations.

In the Danish literature from this period I find only one case. Bang‡ describes a man, sixty years old, who for nine months had suffered from vomiting, gastralgia, and was very emaciated. There was found a cancer occupying the entire inner surface of the lesser curvature.

During this period, then, the symptoms, diagnosis, complications, and the external form of cancer of the stomach were pretty well known, but the real structure and the mode of extension were wholly unknown, since microscopic study was neglected. So far as the stomach goes, three types of carcinoma, the scirrhous, the encephaloid, and the alveolar, were known, but encephaloid carcinoma was not distinguished from that of a granuloma (Prus); nor was any difference known between scirrhous carcinoma and the ordinary connective tissue (Andral).

The next great advance with respect to carcinoma of the stomach was made when the microscopic examination of cancerous tissue began to be carried out; this was a general advance, including all tumors, and was initiated by Joh. Müller§ in 1838 in his famous work on tumors. He taught that what Bichat believed about the body was also true concerning the tumors; in other words, he laid the foundation for the histology of tumors.

From now on the pathologic anatomy of carcinoma of the stomach developed in two directions—histologic and anatomic.

It is not possible to show an independent development in the histology of cancer of the stomach, since it is practically identical with cancer in general. On the other hand, to enter into a historic presentation of the growth of our knowledge about cancer as it developed since Müller's time would carry me far beyond the scope of this monograph. Hence I shall only briefly refer to the main points in connection with the various forms that occur in the stomach when these are under discussion.

The anatomic descriptions begun by Louis, Andral, Prus, and others were carried farther by Cruveilhier, Rokitansky, Dittrich, and many more. Beside hand-books and text-books on pathologic anatomy autopsy records from the larger pathologic institutes, *e. g.*, from Prague, have contributed greatly to our knowledge of cancer of the stomach. The individual articles on this subject will be referred to as we go on, since a collected account of them would be tiresome and without interest.

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* Principles and Illustrations of Morbid Anatomy, London, 1834.

† Diseases of the Stomach, Edinburgh, 1830. ‡ Bibliotek for Läger, 1829, p. 6.

§ Ueber den feineren Bau und die Formen der krankhaften Geschwülste, Berlin, 1838.

OCCURRENCE AND FREQUENCY

Primary carcinoma occurs most frequently in the stomach. Different writers give somewhat variable percentages of its occurrence. Thus, the lowest comes from Tanchou[*] who, in 9118 cases, found cancer of the stomach in 2303 instances—about 25 per cent. Herrick and Popp[†] found cancer of the stomach as frequent as 28 per cent. Higher figures are those from the pathologic institute in Prague. Willigk[‡] found carcinoma of the stomach 169 times in 477 cases of cancer, or about 35 per cent. Halla, Dittrich, and Wrany[§] put the frequency of cancer of the stomach as 39 per cent., and the latest report by Eppinger[||] puts the percentage still higher, namely, 42.5 per cent. Marc d'Espine[**] found the stomach involved in 44 per cent. of 471 cases of cancer collected in Genf, Switzerland. From Norway Kjer[††] reports 908 cases of cancer, 471 of which, or 47.8 per cent., occurred in the stomach. Among the autopsies of the Kommunehospital during 1870–72 there occurred 71 cases of carcinoma, and 19 of these were situated in the stomach, giving a percentage of 26 per cent. My only reason for adding my own small series here is that the percentage corresponds to that given by others. It is plain from these figures that nearly half of all cancers occur in the stomach.

Cancer of this organ is nearly always primary; secondary cancers are rare.

Dittrich dissents from this, for 9 of his 160 cases are reported as secondary growths. However, his descriptions of these are so brief that criticism is impossible, though several of them may be challenged. Still, metastatic tumors through the blood have been observed in the stomach. Thus Dittrich[‡‡] reports three undisputed cases. The first of these occurred in a fifty-three-year-old man who had a primary tumor in the foot. At autopsy secondary growths were found in the stomach, lungs, pleura, and kidneys. The second case occurred in a barber, sixty years of age, who had a scirrhous cancer removed from his right mammary gland a half year before his death. After death medullary carcinomatous growths were found in the cardia, dura mater, brain, lungs, liver, and kidney. Finally, he mentions a woman, forty-eight years old, who suffered from multiple melanotic carcinoma in which several malignant nodules were found in the stomach. I[§§] observed a secondary node in the stomach of a woman, forty-nine years of age, who died from general melanotic sarcoma. Cohnheim,[||||] too, found 14 flat, white, and smooth filtrated with a flat, soft, grayish growth for a radius of 2 cm. In the second case an ulcerated cylindric epithelioma, measuring 7 cm. in diameter, was located on the posterior wall of the pars pylorica. The edge of the ulcer consisted of the infiltrated muscularis and submucosa. This infiltration extended about 1 cm. into the duodenum. In the third case a flat, ulcerated medullary carcinoma, 7 cm. in diameter, was located on the lower part of the anterior wall of the pylorus. At the edge of this tumor were found circumscribed infiltrations, situated partly in the submucosa and partly in the mucosa. The pyloric sphincter and 1½ cm. of the neighboring duodenum were infiltrated. This thickening was most marked in the mucosa, which formed a soft, whitish mass, 3 to 5 cm. thick, movable on the muscularis, which here measured 2 mm. The lymph-nodes of the submucosa were infiltrated with cancer masses.

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[*] Von Lebert: Traité practique des maladies cancereuses, Paris, 1851, p. 517.

[†] Walshe: Nature and Treatment of Cancer, London, 1846, p. 278.

[‡] Prag. Vierteljahresschr., 1856.

[§] *Ibid.*, 1844, 1845, 1846, 1847, 1867, 1868.

[||] *Ibid.*, 1872.

[**] Lebert, *vide supra*.

[††] "Oversigt over Udbredning of de Kräftagtige Sygdomme i Norge.," Norsk Magasin for Lägevidensk., 1870, vol. xxiv, p. 241.

[‡‡] "Die krebsige Entartung des Magens vom path.-anat. Standpunkte aus geschildert," Prag. Vierteljahresschr., 1848, vol. i, p. 24.

[§§] "Beretning am 422 Sectioner," Nord. med. Arkiv, 1873, vol. v.

[||||] Virchow's Jahresbericht, 1867, p. 294.

The most important functional sequela of carcinoma of the pylorus is stenosis. This was present 11 times in my 19 cases. In 5 the stenosis was so slight that the ring admitted one or two fingers; 5 showed a more marked degree, so that the sphincter admitted only the tip of a finger, and in one case there was a complete stenosis. Lebert observed a moderate degree of stenosis in 12 of his 34 cases, which is about the same proportion as I found (one-third). In the more solid chronic forms stenosis is brought about through retraction of the pyloric antrum; the softer tumors may produce the same effect through a simple occlusion. Lebert reports an instance in which an encephaloid carcinoma formed a sort of a valvular structure in front of the pyloric opening. As a rule, however, both the retraction and the occlusion aid in the production of stenosis. Sometimes the stenosis is brought about by larger, soft growths on the edge of a chronic, slow-growing, firmer carcinoma. These soft, fast-growing tumors at times produce marked degrees of stenosis, as seen from the case cited below. Here the stenosis was water-tight.

CASE II.—*Large-cell medullary carcinoma on a scirrhous basis. Firm ulcerating tumor in the pars pylorica. Between the ulcer and the sphincter of the pylorus is a soft, medullary tumor with a rich blood-supply. This has completely occluded the pylorus. Dilatation of the stomach. The hepatic glands are carcinomatous.*

Andreas Larsen, pauper, sixty-one years old. Autopsy May 28th, thirteen hours after death. There is no free fluid in the peritoneal cavity. The peritoneum is normal. The stomach is markedly dilated. The greater curvature measures 98 cm., and the lesser 50 cm. The height at the junction of the fundus and the body is 34 cm. The stomach occupies the entire left hypochondrium and half of the adjacent epigastrium. Its capacit is 3000 c.c. The pyloric end has the feel of a large round, firm nodule when the stomach i filled with water. None of this passes through the pylorus. This is due to a soft spheri tumor, 8 cm. in diameter, which has a broad, firm base and a roughened surface. Thi occludes the highly dilated pyloric end completely, and extends into the duodenum. Th pyloric sphincter is lacking, having been absorbed by the growth. The most prominen part of the tumor is ulcerated. On its surface otherwise it is covered with mucous membrane. A whitish thickening of the mucosa extends from the tumor 7 to 8 cm. into the surrounding stomach-wall. In this mass, on its left side, is found an irregular ulcer, 3 cm in diameter, having an irregular, dirty base and a rough, infiltrated edge. In cross-section the edge of this ulcer is seen to be made up of a whitish, rather firm tissue, from which a milky juice can be scraped. The infiltrated portion is from 1 to 1½ cm. in thickness.

The cut surface of the round tumor is soft and contains red spots (fungus hematoides). The glands at the hilum of the liver are of walnut size and grayish-white in color. They are rather soft.

2. The lesser curvature comes next after the pylorus as regards frequency of cancer of the stomach; 8, or $\frac{1}{4}$, of my cases occurred here. This same condition was observed by Eppinger. In Louis and Wrany's reports the frequency is slightly greater, being $\frac{1}{3}$, but Lebert gives less, $\frac{1}{8}$, and Brinton gives $\frac{1}{9}$. The average of the entire group is 15.6 per cent. In my series the left half of the lesser curvature was the most frequent site, being the origin of the tumor in five instances.

The tumors here often reach a considerable size, perhaps because stenosis does not occur as readily as at the pyloric end, thus permitting the organ to function longer, giving the patient a longer lease on life. Lebert observed a tumor 12 cm. long and nearly as wide, and Eppinger,* in a man of 62, found an alveolar carcinoma of the lesser curvature, which had changed into a swelling as large as a child's head. In my cases the tumors often spread out over large areas. In 5 cases these were as large or larger than an adult's flat hand. The largest masses develop when the growth starts at the lesser curvature and spreads out over the anterior and posterior walls, as occurred in three of my cases. The entire lesser curvature was ulcerated in one of these, and an ulcerated surface extended 7 cm. over the posterior wall and 7 cm. over the anterior. When the stomach is split open and turned out, the entire ulcer often appears as an hour-glass-shaped growth with the narrow part in the lesser curvature. The circumference of the stomach at the fundus is so large that carcinoma perhaps never forms a complete ring around the stomach at this part, as occurs at the pyloric end. At times, however, the spreading edges nearly meet at the larger curvature. Thus, in one of my cases the advancing borders were only 2 cm. apart.

3. Only once did I find an annular scirrhus at the cardia. That cancer of this end of the stomach is not quite so rare as that is clear from the statistics offered by other observers. Lebert, for instance, found the cardia affected in $\frac{1}{10}$ of his cases. Dittrich and Brinton give $\frac{1}{9}$. Wrany found carcinoma of the cardia in $\frac{1}{6}$, and in Eppinger's statistics it occurs as frequently as in $\frac{1}{4}$ of the cases. The average then is 8.6 per cent. The carcinoma of the cardia is not so clearly limited to the stomach as is the case when the pylorus is involved. On the contrary, it often extends (Rokitansky) a varying distance up the esophagus. This had taken place in two of Lebert's and in one of my cases. However, the writers do not agree concerning this point. Förster, for instance, holds that carcinoma is nearly always limited to the stomach, even in this type. Carcinoma of the cardia often produces stenosis either by contraction or by extending into the narrow esophagus, producing occlusion. An instance of this type is cited by Abercrombie† and others.

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* *Loc. cit.*, p. 7.

† Pathol. und praktische Untersuchungen über die Krankheiten des Magens, etc., Bremen, 1830, p. 87.

4. The posterior wall of the stomach seems to be not infrequently the seat of cancer. This is especially brought out by Eppinger's cases, there being 18 instances among his 131 cases. In the collected statistics the posterior wall follows the cardia in order of frequency, its percentage being 4.7. As a whole, the posterior wall appears more predisposed toward cancer than the anterior. This is perhaps due to mechanical factors, since the posterior wall lies right against the spinal column, whereas the anterior wall is everywhere in contact with soft tissue.

5. The average percentage of the greater curvature and the fundus is 3.3 per cent. This comparatively high percentage is also due to Eppinger's observations. In one of my cases a cylindric epithelioma occurred in the form of a pedunculated polyp in the fundus.

6. Diffuse forms of scirrhus and alveolar carcinoma occur in the entire stomach. A comparatively large number of this type have been reported, whereas only a smaller number of cases of carcinoma of the greater curvature and the fundus are recorded. This is not due to the comparative frequency of the two, but mostly to the fact that the diffuse forms have been more interesting than the circumscribed, and perhaps also to the discussion carried on as to the relation of cancer to hypertrophy of the stomach. The collected statistics bring out clearly how rare the diffuse carcinoma really is. It occurs in 2.8 per cent. One of my 30 cases was of the diffuse type.

7. Carcinoma of the stomach is rarest on the anterior wall. It occurs here in only 1.8 per cent.; in 1.4 per cent. it occurs on the posterior and the anterior walls, and only in 1.1 per cent. do several cancer nodules of the same age occur in the stomach.

FORM, SHAPE, AND POSITION OF STOMACH

Frequently the stomach retains its normal shape regardless of the location of a tumor (Lebert). The normal size of the stomach is hard to give, since its cavity varies vastly with the degree of contraction of its musculature. This has led to the wide limit given in figures showing the normal capacity of the stomach. Thus Sömmering* gives the cubic content of a non-dilated stomach as varying between 2500 c.c. and 5000 c.c. According to Luschka,† the female stomach holds 2500 c.c., and the male, 3200 c.c. Henle gives the length as 10 to 12 cm., and Luschka says it may reach 30 cm. Henle gives the depth as 3 to 4 cm., and Luschka as 15 cm. With these measurements as a standard I found the stomach dilated only once in a case of complete stenosis of the pylorus. In this instance the organ measured 50 cm. in length, but held only 3000 c.c. Hence its capacity was within the normal limits. It must be recalled, however, that in this case the entire pyloric end was filled by the tumor mass. Thus the dilatation was limited to the fundus and the body of the stomach.

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* Henle: Handbuch der Eingeweidelehre, p. 153.

† Die Anatomie des menschlichen Bauches, 1863, p. 181.

It has long been considered the rule that the stomach is enlarged when there is stenosis at the pylorus, because the accumulating food gradually increases the capacity of the stomach. Lebert was the first to recognize that this was by no means a constant condition. Still he found dilatation present in at least one-fourth of such cases. The dilatation was slight in several cases, in others more pronounced, and in one of his cases the stomach extended from the fifth rib to the iliac crest. Andral* cites another instance of cancerous infiltration without stenosis in which the greater curvature reached below the symphysis, and in which most of the large and small intestines were covered by the stomach. Such extreme degrees of dilatation are exceedingly rare. Less pronounced degrees of enlargements of the stomach have been so ambiguously reported that they cannot be depended on. How frequently the organ is dilated in carcinoma cannot be determined from the records. The musculature of the dilated stomach at times was atrophied and at others thickened. A decreased capacity caused by retraction of the organ is often found in the diffuse forms of carcinoma, when the entire stomach is involved. This diminution may reach a pronounced degree, so that the stomach may be reduced to the size of an ordinary loop of intestine; hypertrophy of the wall reduces the lumen still more. An old specimen from the museum will illustrate this:

Case III (Old Specimen, Preserved in Alcohol).—The stomach is greatly reduced and shrunken. It is sausage shaped, and about the thickness of the small intestines. It is 14 cm. long, and its diameter at the fundus is 6 cm., and that at the pylorus is only 3½ cm. The cavity of the fundus holds two fingers, and the pyloric lumen admits only the little finger. A No. 16 French catheter passes with difficulty through the pyloric orifice. The peritoneal surface of the stomach is smooth. On the inner surface occur flat nodules from the size of a pea to that of a nut, which are more numerous at the pyloric end. The entire stomach-wall is diffusely thickened. The wall at the fundus is 8 mm. thick, ½ mm. of this comprising the serosa; the muscularis is 2 mm., the submucosa, 4.5 mm., and the mucosa, 1 mm. thick. In the pyloric end the wall is 1 mm. thicker than that of the fundus. The mucosa appears as a distinct border, independent of the tumor in the submucosa. A network of white bundles is seen in the muscularis. Microscopically the mass consists of connective tissue with numerous elastic fibers running through it. The finer structure cannot be made out because of the great age of the specimen.

The stomach is often decreased in size, even in the circumscribed carcinomata. There is an old rule that cancer of the cardia diminishes the size of the stomach, since too little food enters. This rule has not been disproved, and in my case of cancer in this part of the organ the entire stomach was not larger than the normal pyloric antrum. But even when the carcinoma is located on the lesser curvature or at the pylorus, the capacity may be greatly reduced. Thus the stomach held only 520 c.c. in one of my cases of a circular carcinoma at the pylorus. In two instances of carcinoma of the lesser curvature the capacity was respectively 250 and 450 c.c., and the length of the organ was reduced to 14 and 16 cm. On the whole, the stomach is more frequently reduced than increased in size in cancer. The cubic content was less than normal in six of my cases, and more than normal in only one. Changes of shape are frequent in carcinoma of the stomach. Thus the organ is sausage shaped in case of diffuse cancers. When the carcinoma is at the pylorus, the right half of the stomach may be sausage shaped and the left half spheric. Such was the case in a scirrhous carcinoma to be described later. Again, Dittrich* found the stomach changed into a round structure about the size of an orange. The carcinoma was situated on the lesser curvature. This was entirely destroyed, and the cardiac and pyloric orifices were approximated to such a degree that food passed from the cardia directly into the duodenum without entering the rest of the stomach, which formed a sort of lateral dilatation between the two approximated parts of the digestive canal.

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* Clinique Medicale, vol. iv, p. 83.

Carcinoma of the lesser curvature extending over the anterior and posterior walls is accompanied by contraction, forming the well-known hour-glass stomach. The stenosis thus produced rarely reaches an extreme degree, since the stomach is rather roomy at this point. As the hour-glass stomach is not very common, I propose to go into some detail in considering the two cases I have had.

CASE IV.—*Carcinoma with cells of medium size. Large semisolid ulcerating tumor on the left half of the lesser curvature. Stricture in the middle of the stomach. Soft medullary carcinoma of the hepatic, the retroperitoneal, and the esophageal lymph-glands. Diffuse peritonitis.*

Johan Müller, age forty-nine, laborer. Autopsy September 21, 1872, twenty-four hours after death. The peritoneal cavity contains 370 c.c. of a purulent fluid. A fresh fibrinous coating is present on the peritoneal surface of the small intestines, as well as on the parietal wall of the peritoneum. The stomach is adherent to the left lobe of the liver, and contains 1000 c.c. of a grayish fluid. The stomach is distinctly narrowed at the center, but the stricture admits five fingers readily. This constricting ring divides the organ into two nearly equal parts. The peritoneal surface is free from carcinomatous growths. Along the lesser curvature is found a carcinomatous ulcerated tumor, 9 cm. long. It extends 5½ cm. down over the posterior wall and 3 cm. over the anterior, and from the rough, somewhat stenosed cardiac orifice to half-way between the cardia and the pylorus, so that the right edge of the tumor reaches to within 6 to 7 cm. of the pyloric sphincter. There is a small tumor in the neighboring omentum. The mucosa surrounding the ulcer is thin and pale, without signs of cancerous infiltration.

A more pronounced constriction in the middle of the stomach occurred in the following case:

CASE V.—*Mixed "cylinder-cancroid" and carcinoma. Semisolid, very large, ulcerated tumor, occupying almost the entire lesser curvature and extending far out over the anterior and posterior walls of the stomach. The floor of the ulcer is even and firm. Constriction in the middle of the stomach. Mixed carcinoma in the hepatic glands and in the liver. Miliary carcinoma of the peritoneum.*

Sophie Larsen, fifty-nine years old, widow. Autopsy December 30, 1871, twenty-four hours after death. The stomach is hour-glass shaped, due to a constriction at the very center of the organ. The constricted part barely admits two fingers. · Along the external surface of the lesser curvature is an irregular mass of tumors varying in size from a pinhead to a walnut. These appear as white nodules on a red background—the injected peritoneum. From the lesser curvature the tumors have extended into the lesser omentum and the hepatic glands. The bile-passages are open, but on the neck of the gall-bladder is a white, pea-sized, soft, and freely movable tumor. When the stomach is laid open, a large ulcerated carcinomatous tumor is seen to occupy nearly the entire lesser curvature. It has spread 5 cm. over both anterior and posterior walls, so far that the edges are separated by only 2 cm. of comparatively normal mucosa, in which are found numerous pea-sized nodules at the periphery of the advancing tumor.

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* Prag. Vierteljahresschr., 1846, vol. iv, p. 168.

Very marked changes of position are not to be expected in an organ situated like the stomach. The cardia is fixed, and the pylorus and duodenum have but very limited motion. However, carcinoma of the pylorus may, by its weight, either pull the pyloric end down into the abdomen, or, what is more frequently the case, may slide it down over the left side of the inner surface of the spinal column. These movements are possible only when the pyloric end is free from adhesions. By this movement the pylorus is made to lie directly below the cardia, and consequently the stomach has a perpendicular, instead of a transverse, position. This condition was first noted by Notta,* who found an instance where the cancerous pylorus had sunk down to the edge of the true pelvis and was compressing the iliac vessels. The lengthened lesser curvature ran perpendicularly and nearly parallel to the greater curvature. In my series there occurred four instances of carcinoma of the pylorus in which the stomach was more or less perpendicularly situated, because the pylorus had slid to the left without sinking to any degree. Only once did I find the lesser curvature lengthened to any considerable extent (20 cm.). This occurred in a case of adenocarcinoma of the posterior wall of the pylorus. This had slid down on the left side so that the tumor was felt during life in the left hypochondrium. But the lengthening of the curvature was not so much due to a sinking down of the pylorus, as it had come about through the large tumors of the lymph-glands behind the pylorus over which the lesser curvature had to pass.

THE MUCOUS MEMBRANE OF THE STOMACH

The mucous membrane not involved in carcinoma of the stomach is often the seat of a more or less marked chronic catarrh. The mucosa is either thinner than normal and atrophied, or diffusely thickened, with a pronounced "état mamelonné," and with or without diffuse pigmentation (Lebert,† Köhler‡). Fenwick§ has studied the minute changes in the mucosa in five cases of carcinoma of the stomach. He found the glands more or less abnormal in all. The cells were either granular, or changed into granular masses, the cell outlines being lost, and in a few cases they had been entirely displaced by connective tissue. Fenwick believes the mucous membrane to be more or less changed in all cases of carcinoma of this organ.

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* Lebert and Köhler: *Loc. cit.* † *Loc. cit.*, p. 471. ‡ *Loc. cit.*, p. 285.

§ The Morbid States of the Stomach and Duodenum, London, 1868, p. 344.

I have examined the stomach mucosa of 20 cases, and found the following conditions:

The mucosa appeared healthy and of normal thickness in 7 cases. In 4 of these the glands were unchanged, but the gland-cells of the remaining 3 were granular. In 4 instances there was a softening of the mucosa, which, however, looked like postmortem changes. The mucosa of 4 of my cases was atrophied and anemic. The gland-cells of 1 of these were unchanged, but in the other 3 the glands were few, indistinct, and often contained a granular débris without distinct cells. In 1 case the mucosa was atrophied and diffusely pigmented. Glands could be made out with difficulty in this instance. All that could be found were a few scattered gland fundi filled with granular débris. The mucosa was thickened in 2 cases. In both of these the glands were normal. Three times I found the mucosa thickened and diffusely pigmented. In 1 of these the glands were unchanged, but in the other 2 the glands, though distinguishable, were changed so that the gland-cells were highly granular in 1 and changed to detritus in the other.

It is difficult or, more correctly, impossible to decide how great a factor the postmortem changes which occur early play in the production of the granular appearance of the gland-cells, because the secreting cells are very sensitive and rapidly undergo degeneration. But the existing atrophy is a definite pathologic change. When the glands are not visible even as dilated spaces filled with detritus, one is, without doubt, dealing with changes present prior to death. There is every reason to believe that atrophy was present during life in the cases where a granular débris was present in place of the glands. But too much importance must not be placed on the granular appearance of the gland-cells. Leaving such changes out of consideration, there still remain five cases in which the glands were more or less atrophied, but against these stand three cases in which both the mucosa and the glands were normal, both in appearance and in structure. For this reason I cannot agree with Fenwick, who claims that changes are present in all cases of carcinoma of the stomach.

Adhesions

Adhesions to the neighboring organs play an important and beneficent part in the otherwise sad drama of carcinoma of the stomach, because they hinder or prevent perforations into the large peritoneal cavity. The stomach may become adherent to any one of the surrounding organs. The particular one depends entirely on the location of the tumor, since adhesions outside of its immediate locality are very rare. This is due to the fact that the chronic irritation causing the formation of the exudate is rarely violent enough to cause inflammation outside of the periphery of the carcinoma. Adhesions rarely form before the carcinoma has entered or gone through the muscularis.

Because of the relation of the stomach to other organs, exudate on the anterior wall forms adhesions to the liver—most frequently to the left lobe. The posterior wall will form adhesions to the pancreas and the posterior wall of the lesser peritoneal cavity; the fundus becomes adherent to the spleen and the diaphragm, and the greater curvature adheres to some part of the intestine—most frequently to the transverse colon. When some writers mention adhesions to the mesentery as being of frequent occurrence, this appears to me to be more or less incorrect, because the larger omentum is normally fastened to the stomach. When this, through the presence of a malignant tumor, is made to contract, and is pulled toward the greater curvature, it is principally the connection of these two organs that forms the adhesions.

It is generally recognized that the stomach most often becomes adherent to the left lobe of the liver. Lebert found such a condition present in 12 of 20 cases. The pancreas comes next in order of frequency. It was adherent in 7 of 20 cases. This does not correspond exactly with the frequency according to location since, as has been mentioned, carcinoma occurs more often on the posterior wall than on the anterior. In my 30 cases the stomach was adherent to the pancreas in 6 instances, and only in 4 to the left lobe of the liver.

Carcinoma of the lesser curvature extending on to the anterior and posterior walls was accompanied with adhesions in the majority of my cases, namely, in 6 of 8. Twice the stomach was fastened to the pancreas alone, twice to the left lobe of the liver, and twice to both these organs. One of the cases without adhesions terminated in perforation and subsequent death from peritonitis. The other led to a pronounced carcinoma of the liver, killing the patient at an early stage of the disease.

Carcinoma near the pylorus seemed less apt to produce adhesions in my cases. Thus adhesions were found in only 3 of 18 cases. In 1 of these the stomach adhered to the transverse colon; in another, to the pancreas; and in the third, to the left lobe of the liver. The comparative rarity of adhesions in carcinoma at the pyloric end is doubtlessly due to the fact that this end is more movable than the lesser curvature, and the slight motion of this part may be still more restricted by tumors in the gastrohepatic ligament. These lead to a contraction lacing the stomach tighter to the hilum of the liver.

COMPLICATIONS AND SEQUELÆ

Some of these are closely connected with the carcinoma and the changes produced by it, others are more distantly related to the malignant growths and may be purely accidental.

Abnormal communications between the stomach and other organs must be ranked first among the direct sequelæ of carcinoma. It is by no means rare that the destruction of carcinomatous tissue continues into an adherent neighboring organ, producing a fistula.

A passage between the pylorus and the transverse colon was found 6 times in Dittrich's 160 cases, and once in 20 by Lebert. This condition must be suspected when, during the course of the disease, fecal vomiting occurs. Ulmer* who bases his views on one case, considers such an un-natural communication to have a beneficent effect on the course of the disease, by removing the effects of stenosis at the pylorus and permitting food to pass directly into the larger intestines.

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* "Einige Worte über Magenkrebs," Würtemb. med. Correspondenzblatt, 1852, Jahresber. 1852, vol. iv, p. 295.

Fistulous communication between the stomach and the pylorus is most frequently due to carcinoma. Murchison* has collected 33 cases of fistulous formation between the stomach and the colon; 20 of these were due to carcinoma; 8 of the remaining were caused by gastric ulcer; 1 was due to carcinoma of the colon; 2 to ulcer of the colon, and 2 were produced by an abscess in the abdominal wall rupturing both into the stomach and into the colon. According to Murchison, the symptoms of this condition are fecal vomiting, foul breath, and the passage of undigested food per rectum. I found no abnormal communication between the stomach and the colon in my cases.

Fistulous connection between the stomach and part of the small intestines is much rarer than that between the colon and the stomach (Rampold†), but it may occur with the duodenum at its junction with the jejunum (Cruveilhier‡).

Rupture into the peritoneal cavity is not rare. It occurred in 3 of Lebert's 57 cases, and in 7 of 160 according to Dittrich. I found this condition present twice—once through a semisolid ulcerated tumor of a mixed type, located on the upper wall of the pyloric end. The floor of the ulcer was made up of cancerous tissue, and in the center of this was a pea-sized opening with smooth edges. The other instance was an ulcerated scirrhous carcinoma on the lesser curvature, extending over both the anterior and the posterior walls. At the bottom of this ulcer, on the anterior wall, was an opening 1 cm. in diameter. Rupture of the floor of the ulcer may at times be caused by mechanical factors. Williams§ cites a case in which the perforation took place while he was making the patient sit up in bed. Just as the patient sat up he heard a sound which he considered was caused by the perforation.

Fistulæ between the stomach and the left lung are very rare, but may be established when perforation of the diaphragm occurs (Lebert and Andral).

Perforation of the abdominal wall is also very rare. Dittrich observed this once, and Murchison‖ found a medullary carcinoma of the stomach connected with an abscess which had broken through the skin in the region of the umbilicus.

Peritonitis without perforation occurs in a number of patients with carcinoma of the stomach. Dittrich** calls attention to this condition. He believes that the changes present on the external surface of the stomach immediately preceding the rupture led to peritonitis in 6 of his 160 cases. But he also found peritonitis present in 8 of his cases without signs of threatening perforation. These, he thinks, are "dyscrotic." Lebert is remarkably silent about these forms of peritonitis. Köhler holds this form of peritonitis to be due to acute cachectic changes in the organism produced by rapidly growing medullary carcinomata or caused by changes in the blood (anemia). I found peritonitis without perforation in 2 of my cases. One of these was a cylindric carcinoma in the pyloric end, with a soft node as large as a nut on the serous surface of the stomach. A slight amount of purulent material could be pressed into the peritoneal cavity from a couple of small openings in this nodule, although the openings were not in direct communication with the stomach cavity. This instance must be considered analogous with those observed by Dittrich in which perforation was imminent. My second case was the carcinoma on the lesser curvature mentioned above (Case IV), in which peritonitis seemed to be caused by the large metastatic nodules in the hepatic glands.

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* Lancet, 1857, vol. i, p. 19; Jahrber. 1857, vol. iii, p. 182.

† Köhler: *Loc. cit.*, p. 283.

‡ Maladies de l'estomac, Livraison 27, Pl. I, Fig. 2, Texte, p. 3.

§ Med. and Surg. Rep., 1868; Jahrber. 1868, vol. iii, p. 128.

‖ Transact. London Pathol. Soc., 1869, vol. xx, p. 167; Jahrber. 1870, vol. ii, p. 308.

** *Loc. cit.*, p. 26.

Ascites is frequent. It was present in 10 of my cases. In 5 instances the amount exceeded 1000 c.c. In 6 the ascites was due to multiple carcinomatous growths in the peritoneum. Fluid in the peritoneal cavity was present 4 times without malignant growths in the peritoneum. The retroperitoneal glands were carcinomatous in 2 of these, 1 had malignant thrombosis of the portal vein, and there was no local cause for the ascites in the tenth.

Hemorrhage into the peritoneal cavity is not common. It comes from highly vascular tumors in which the serosa is destroyed. It may at times become serious enough to cause death, as in the following case:

CASE VI.—*Medullary carcinoma. Small, soft, ulcerated tumor in the pyloric end, close to lesser curvature. A walnut-sized soft vascular tumor (fungus hematoides) between the serosa and the muscularis in the pyloric end of the stomach. This has broken through the peritoneal coat and caused a considerable amount of hemorrhage into the peritoneal cavity. Large soft tumors in the liver. Smaller nodules in the omentum; carcinomatous degeneration of the lymph-glands of the lesser curvature.*

Niels Johansen, forty-four years old, laborer. Autopsy April 20, 1872, twenty-four hours after death. A small amount of fluid was detected in the peritoneal cavity a few weeks prior to death. This increased greatly during his last days. In the peritoneal cavity two quarts of liquid blood, which contains red and white cells in normal proportions and is free from other formed elements.

The stomach is of normal size and shape; the pyloric end is not constricted to any marked degree, although a round, flat, ulcerated tumor of soft consistence and yellowish-gray color is situated on the anterior surface near the lesser curvature, and about 2 cm. from the pylorus. This tumor is 2 cm. in diameter and 1½ cm. in height. It originates in the wall, and rises perpendicularly up from the mucosa. The ulcerated surface is covered with irregular shreds and villi, between which are small, pale-red coagula. On the serosa opposite this tumor is a group of yellowish-gray nodules, varying in size from a pin-head to that of a hempseed. There is a soft, dark-red, walnut-sized tumor on the posterior wall of the stomach. The surface of this is roughened here and there, but otherwise covered with peritoneum. The cut surface simulates a coagulum. The tumor is situated in the connective tissue between the serosa and the muscularis. It is loosely adherent to the normal muscularis. The mucosa is unchanged. The liver is changed into a nodular mass. On its surface are numerous soft, semispheric tumors, of a yellowish-gray color, and varying

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in size up to that of goose-eggs. Some of these fluctuate. The liver tissue makes up but a small part of the liver mass, which is 31 cm. wide, 25 cm. vertically, 11 cm. anteroposteriorly, and weighs about 6 kilos. Near the gall-bladder is a nodule as large as a goose-egg, having a rough surface, covered with petechiæ. This is loosely adherent to the transverse colon.

Icterus occurs at times. It is due either to compression of the gall-passages by carcinomatous lymph-nodes, or to carcinoma of the passages themselves. In one of my cases carcinomatous glands at the hilum of the liver compressed the ducts, and in another case a part of the gall-bladder, the cystic duct, and the ductus choledochus were changed into a whitish-gray mass, 2 to 4 mm. thick, by carcinomatous infiltration, the lumen being entirely obliterated, making the passage of bile impossible.

Granular and fatty degeneration of the myocardium is not unusual in persons suffering from carcinoma. E. Vagner* observed that about one-sixth of ulcerating carcinomata of any part of the body lead to fatty changes in the heart. I found fatty degeneration of the heart in 9 of my cases. In 2 the carcinoma of the stomach was uncomplicated by any other disease, but of the 7 others, 1 had adhesive pericarditis, 2 had icterus, 1 peritonitis, 1 a large abscess between esophagus and the trachea, 1 suffered from lobar pneumonia, and the seventh had parenchymatous nephritis. I cite these complications because they alone might produce granular degeneration. This precaution has not been taken by Vagner in the two cases of carcinoma of the uterus where fatty changes were present in the heart, for both of these had diffuse peritonitis. Just how great a percentage of his cases showing fatty degeneration of the heart were complicated by diseases other than carcinoma is hard to estimate, but the carcinoma probably has a less severe influence on the heart than he has indicated. Still, my two cases of uncomplicated malignant growth of the stomach clearly indicate that carcinoma can produce fatty changes in the heart.

Marantic thrombosis of the large veins is not a rare complication of carcinoma. Dittrich found thrombi in the veins of the lower extremities in nine cases, and of the transverse sinus twice. One of my cases had thrombosis of both crural veins, 2 had thrombi in the crural vein and in the inferior vena cava, and 1 of the portal vein.

Lobar pneumonia, which Dittrich looks upon as a secondary disease, occurs frequently. Thus it was found in 5 of my cases. In 2 instances it was bilateral. I fail to see any etiologic relation between these two diseases, although the frequency of secondary pneumonia does indicate that such exist, since one-sixth of my cases had pneumonia; but other observers fail to find such a high percentage. Thus Dittrich found only 5 instances of secondary pneumonia, *i. e.*, 1 in every 31 cases, and Lebert saw only 1 in 57.

Secondary croupous processes in the large intestines may readily be conceived as having a connection with carcinoma of the stomach, since gangrenous decomposition products might cause this by their passage through the bowel. Dittrich was the first to call attention to this sequel, of which he found 16 instances. It is doubtful, however, if the cause of croupous colitis is to be found in the carcinoma, because neither Lebert nor I found a single instance of this type.

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* Die Fettmetamorphose d. Herzfleisches, Leipsic, 1864, p. 113.

Simple catarrhal enteritis is not rare. Lebert emphasized the fact that the large intestine is more frequently involved than the small. Dittrich gives 9 cases of acute catarrhal colitis and 4 of ulcerative folliculitis. The intestines were rarely involved in my cases. I only saw 1 instance of acute catarrh of the small intestines. Follicular ulcers were present both in the large and small intestines in one of my cases, but in this particular case there was an acute spreading tuberculosis of the lung, hence the ulcerative condition of the bowel might easily be connected with that.

The purely accidental complications are of little interest, with the exception of chronic tuberculosis of the lungs. It is well known that carcinoma and tuberculosis rarely occur together, and, according to the old notion, one of these bars the others. Cruveilhier did occasionally find them in the same person, but he thought they never originated during the same period. Martins,* who collected a number of cases of this nature, came to the conclusion that the two diseases occur together, although very rarely. Thus only 1 out of 150 cases of carcinoma seems to be associated with tuberculosis, and yet both may start at the same time. In Martin's cases of this kind the large majority of the carcinomata—9 in 13—were located in the stomach. I found the two diseases present together in 1 of my cases; here the tuberculosis was much more recent than the carcinoma, and had started when the carcinoma was at the zenith of its growth.

Other complications present in my cases were pachymeningitis interna, twice, in a woman seventy years old, who had scirrhous carcinoma of the pylorus, and in a woman fifty-one years of age, who had a medullary carcinoma of the pylorus. Dittrich considers this form of meningitis a consecutive disease, and holds it to occur frequently. But a direct connection is hard to find. Pachymeningitis is not rare in older persons, and it may be that the fact that both these diseases occur in older people is the only real connection between them. Nephritis occurred twice, fatty liver twice, scirrhosis of the liver, bronchitis, hypostatic pneumonia, polypus uteri, oöphoritis, abscess between esophagus and trachea, and a decubital ulcer, each once.

ORIGIN AND DEVELOPMENT OF CARCINOMA OF THE STOMACH

(*A*) *Point of Origin.*—It is hard to decide whether the carcinoma originates in the mucosa, submucosa, muscularis, or serosa, since the early stages of primary carcinoma in this organ can be seen only in patients dead from other diseases, and then the disease is usually overlooked. In order to decide this question it is necessary to have a large series of carcinomata at a very early stage, when only one layer is involved. Accurate descriptions of carcinoma in this stage are not found, largely be-

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* Die Combinationsverhältnisse des Krebses und Tuberculose, Erlangen, 1853.

In what way the muscular bundles are destroyed has not been definitely explained up to the present time. Dittrich* states that it is difficult in the later stages of cancer to decide whether the muscular bundles are forced aside by the malignant cells or are destroyed by being infiltrated by cells. Rokitansky believes that they undergo atrophy due to proliferation of the connective tissue between them, and Förster agrees with him in this. On the whole, however, writers so far have paid but scant attention to this point. For this reason I shall discuss it in some detail, and describe the condition I have found present in all types of carcinoma studied by me. This excludes alveolar cancer, since there was no opportunity to observe this form in my cases.

At first the carcinomatous cells extend from the submucosa down between the larger muscular bundles. Granulation tissue is often found in the connective-tissue framework in the neighborhood of the cancer mass. The malignant tissue is then seen to form white bundles and partitions around the grayish, transparent muscle substance. In these cases the cancerous tissues are completely developed, containing both alveoli and stroma. From the interstitial tissue of the larger bundles the malignant cells next extend between the smaller muscular bundles. Finally, the cancer-cells penetrate between the individual muscle-fibers, and these are then destroyed by fatty degeneration. This condition is illustrated in Fig. 1 of Plate I, which represents a section of the musculature of the lower part of the esophagus. It came from a case of ulcerated scirrhous carcinoma of the cardia in which the muscular layer was thickened due to infiltrated cancerous masses. In the center of the picture at 1 appears a bundle of smooth muscle-fibers cut longitudinally, and between them are seen groups of cancer-cells which are without stroma and lie naked against the muscle-fibers. In some of these (at 5) are found oblong groups of fat-granules. On either side of these longitudinal layers are swollen muscle-bundles cut crosswise (at 3), and between the individual fibers of these occur groups of malignant cells which have forced the fibers apart and separated them into irregular groups. I was unable to find any evidence of the muscle-fibers taking an active part in this process. There was no pronounced division of nuclei or any transition of muscle-fibers into cancer-cells. The formation of fat-granules which, as far as I can determine, begins near the nuclei of the fibers, indicates the destruction of the musculature by fatty degeneration.

(c) *The Mucosa.*—The mucosa was rarely considered as the point of origin of cancer by older writers. Thus Prus† had not personally seen a single instance of this kind, but cites a case observed by Andral in support of the theory that the mucosa may be the site of primary cancer, while the other layers are unchanged. But the case to which he refers was not malignant, as is plain from the description given by Andral,‡ who also considered it as a case of chronic catarrh of the stomach in a person with tuberculosis of the lungs with ulcers in the ileum. Rokitansky thinks that certain forms of medullary carcinoma may occur as diffuse infiltration of the mucosa, but that this layer is far less frequently the primary site of cancer than is the connective tissue of the submucosa. At the present time, however, the mucosa has become the center of interest, and it is now looked upon as the point of origin of carcinoma in an entirely different proportion of cases than earlier. It was first observed that certain types of cancer—the cylinder-celled carcinomata—originated here (Reinhardt, Förster, Virchow, etc.) Later on, Cornil called attention to the fact that medullary carcinomata also originated in the mucosa, and finally Waldeyer has recently advanced the view that all types of cancer of the stomach have their starting-point in the mucosa.

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* *Loc. cit.*, p. 9.

† *Loc. cit.*, p. 49.

‡ Clinique medicale, vol. iv, p. 397.

(*B*) *Development.*—Without attempting to give a developmental history of cancer, I wish to bring out the salient features of the various theories held today. I shall limit myself to carcinomata, since the sarcomata are very rare in the stomach. The characteristic thing about carcinomata is the fact that each growth consists of two elementary substances, viz., the connective tissue and the carcinomatous cells. The connective tissue forms the supporting framework carrying vessels and forming the walls of cavities of varied form, shape, and arrangement, the alveoli containing the other elementary substance—the cells. This fundamental structure is found in scirrhous carcinoma, cancroids, and colloid cancer, which are the different types occurring in the stomach. The real query then becomes, where do the alveolar cells originate? They are the central point in the development of cancer, and since Joh. Müller's time the attention of observers has been focused on them.

(*a*) *Development from Connective-tissue Cells.*—The old notion that these cells originate from amorphous ones as exudates from the blood and lymph-vessels was overthrown by Virchow, who advanced the theory that they originated from the mother-cells of the connective tissue. Since Virchow is the originator as well as the main representative of this theory, at present held by a number of our best histologists (Förster, Rindfleisch, and others), I wish to recall his ideas concerning the origin and development of cancer.

Virchow* divides the development of cancer into five stages: (1) The irritative stage forms the beginning and is characterized by changed nutritive conditions in the connective tissue produced by the cancer poison (he does not give the character of this poison), whereby the connective-tissue cells undergo an active proliferation similar to that of ordinary inflammation, giving rise to masses of non-differentiated cells—granulation cells. (2) The next is called, after these cells, the granulation stage. At this stage the tumor cannot be recognized from ordinary inflammatory tissue. The non-differentiated cells are like those of a young tubercle. There is this inherent difference, however, that only the malignant cells are capable of further development. This difference is shown by recurrence of the malignant tumor in the apparently healthy tissue surrounding a removed cancer. It is the connective tissue that has the most pronounced ability to form granulation tissue, hence cancer most frequently develops from connective tissue. (3) In the third stage—the stage of differentiation—changes characteristic of malignancy, by which the specific structure of carcinoma is produced, occur, and first in the granulation tissue. The undifferentiated cells now develop along two distinct lines. One part of them is changed into connective tissue and vessels, forming the tumor stroma; the others assume the form and appearance of epithelial cells, either cylindric, squamous, or transitional, and these epithelial cells fill the spaces formed by the stroma and make up the alveolar contents. (4) The fourth stage is the flowering stage, and, (5) the fifth the stage of retrogression, have nothing to do with the development, and hence are left out.

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* Onkologie, 1863, p. 77.

(*b*) *Development from Preëxisting Epithelial Cells.*—As early as 1847 Virchow[*] pointed out the similarity of carcinomatous cells and epithelium without, however, thinking about a genetic relation between them. In 1854 Remak[†] demonstrated the development of the epithelioma of the skin from the secreting cells of the sebaceous and sudoriparous glands. He held that the cancer mass was of similar structure to these glands, and suggested the name adenoma for them, because the cancer growths develop similarly to the glands in the embryo. He, therefore, pointed out an entirely new mode of development for cancer-cells, namely, origin from preëxisting epithelial cells in the glands of the skin. Such a view was entirely contrary to the belief then held that the malignant cells developed from amorphous "blastomer." For a long time Remak's observations stood alone and did not prevent Virchow's theory of origin from ordinary connective tissue from being generally accepted. Meanwhile the epitheliomata (Hannover[‡]), or squamous cancroids, as they were called by Alibert, became separated from the other types, and as far as these tumors were concerned, Remak's theory as to their origin was definitely proved by Thiersch,[§] who added that cells of the rete malpighii, as well as the gland-cells, might become the origin of cancer-cells.

As far as cancer of the stomach goes, it was of greater interest that the real origin of cylinder-celled cancroids became known (Reinhardt,[‖] Bidder,[**] and Virchow[††]), because these tumors were first found in the stomach. So far as these tumors go, it was known from the very beginning that the gastric glands played a part in their development. Waldeyer[‡‡] made it sufficiently plain that the relation between the stomach glands and these cancers was the same as that between the glands of the skin and the epitheliomata. Cornil[§§] had, to be sure, come close to the truth when he observed the enlargement of the glands and the

[*] Virchow's Archiv, 1847, vol. i, p. 94.

[†] "Ein Beitrag zur Entwickelungsgeschichte der krebshaften Geschwülste," Deutsche Klinik, 1854, p. 170.

[‡] Das Epitheliom, Leipsic, 1852.

[§] Der Epithelialkrebs nämentlich der Haut, Leipsic, 1865.

[‖] Annalen d. Charité, 1851, vol. ii, p. 1.

[**] Müller's Archiv, 1852, p. 178.

[††] Gazette Med. de Paris, 1855, p. 211.

[‡‡] "Die Entwickelung der Carcinome," Virchow's Archiv, 1868, vol. xli, p. 470.

[§§] "Contribution a l'histoire du developpement histologique des tumeurs epitheliales," Journal de l'anat. et de physiol., 1865, vol. ii, p. 266.

development of branches on the side of the fundi, and also the disappearance of the membrana propria, but instead of considering these bare cell-masses the content of the alveoli, he thought epithelial cells were formed in the stroma.

When it had been proved that the cells of the cancroids, both squamous and cylinder-celled, originated either from gland-cells or other epithelial cells, it was yet left to show whether the other forms of carcinoma have a similar starting-point, and Waldeyer* showed that there is no difference between cancroids and other carcinomata, and now holds that the cells of the carcinomata in general spring from preëxisting epithelium either in the skin, the mucous membrane, or in the glands.

When there is no difference in structure, it seems reasonable that there should be a common mode of development of all varieties of the same type of tumor.

According to German writers, more especially to Virchow,† the difference between "carcinoma" and "cancroid" consisted in that the cancroids had large alveoli visible to the naked eye, which were filled with epithelial cells; between the alveoli occurred a stroma made from the connective tissue of the involved organ, and not from the new-formed tissue. The "carcinomata," on the other hand, had small alveoli the cells of which originated from granulation tissue, part of which developed into cells and part into stroma. Such a conception as to the character of these two forms of tumors had the weakness that it was based both on form and on development, and it was impossible, in an individual case, to decide whether the stroma had developed from the new-growth or from preëxisting connective tissue. French histologists never recognized this difference. In Robin's‡ "Tumeurs heteradeniques" the alveoli contained at times squamous and at other times round- or angular cells, hence they include both the squamous cancroids and the carcinomata. Cornil§ shows that the difference between cancroids and carcinomata described by the Germans does not exist, but he fails to arrange them into a single group, consequently he only adds to the already existing confusion by suggesting new forms with strange names. Waldeyer was the first to have courage enough to annul the theoretic difference which had caused so much confusion in the description of tumors. At the same time as he was tearing down this theoretic distinction he sought to show that both varieties have the same origin, namely, from preëxisting epithelial cells.

Accepting the theory that carcinoma springs from epithelium, its development, according to Waldeyer, must occur as follows: In an organ containing epithelial cells, for example, glands, or the mucosa of the alimentary tract, the acini develop irregularly. The gland-cells proliferate first, filling the acini, then dilating them, and finally grow as cell-buds out in the surrounding tissue. These protruding cell-masses are designated carcinomatous bodies by Waldeyer. At first they appear as buds on the sides of the acini, but soon they can be distinguished from these by the fact that they are not limited by a basement-membrane and form solid masses of cells. The carcinomatous masses, growing still further out in the surrounding tissue, continually branch in all directions, forming an anastomosing network of cells, which in cross-section form the alveolar contents. The connective tissue surrounding the cancer-cell is at first simply the stroma of the original gland. Soon granulation cells appear. These may come either from the proliferation of the existing connective-tissue cells or from the blood. Waldeyer calls this process "periacinöse oder intralobuläre Wucherung," and he considers this granulation tissue simply a by-product, playing a subordinate part in the development of the carcinoma, contrary to Virchow who holds the granulation tissue to be a single stage in the development of the tumor. The stroma of the carcinoma is, therefore, composed partly of preëxisting connective tissue and partly of periacinous granulation tissue. The numerous writers on cancer adhere to one or the other of these two theories.

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* Virchow's Archiv, 1872, vol. lv, p. 67.

† "Ueber Cancroide und Papillargeschwülste," Virchow's gesammelte Abhandlungen, 1862, p. 1018.

‡ "Memoire sur le tissu heteradenique," Gaz. hebd. 1856.

§ "Memoire sur les tumeurs epitheliales du col de l'uterus," Jour. de l'anat. et de las physiologie, 1864, vol. i, p. 472.

In my work on Carcinoma of the Stomach I have paid particular attention to the development by means of a thorough study of the mucosa at the edge of the tumor. I shall give my observations more in detail in connection with the individual cases, but in general I have found Waldeyer's theory to hold good in many of my cases. However, I have been unable to find it true, as he has, in every case. At this point I wish to present Waldeyer's ideas of the development, and explain it by a case which is interesting in this connection.

Prior to Waldeyer, the connection between the gastric glands and carcinoma was recognized but once by Cornil,* to which I have already referred. Waldeyer found that the degenerated gland-cells at first broke through the muscularis mucosæ and then rapidly invaded the readily movable, loose submucous connective tissue. At this point the real cancer nodules are formed. They occur at first as small isolated knobs, which suggest their analogy to the gastric glands, and later these grow together, forming diffuse masses. He has proved, furthermore, that both the gastric glands and the mucous glands at the pylorus may be the starting-points of cancer. It was only rarely that a larger portion of the gastric glands underwent carcinomatous degeneration—nearly always a small group of glands, 10 to 20 individual fundi, or even less, became malignant. As soon as these penetrated the muscularis mucosæ a rapid development took place, leading to the formation of a large node, connected with the glands above by a small pedicle. This pedicle is not always in the very center of the tumor, but often lies to one side, so that a series of sections is often needed to find it. The gastric glands surrounding the malignant cells are often dilated in their lower ends. They appear as bottles, with narrow necks and wide bottoms, filled with cells staining more intensely than normal gland-cells with carmin.

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* Robin's Journal, 1865, p. 476.

In certain parts of the tumor mass in the mucosa there occur carcinomatous bodies so arranged as to look like hypertrophied gastric glands, giving the tumor the structure of an adenoma. In other places no distinct architecture is followed, but irregular figures, now round, and then irregular, with spikes or branches on the sides, occur, thus deviating from the structure of adenoma.

Cornil thought the dilatation of the lower ends of the gastric glands was due to the following changes: the surface villi or papillæ were lengthened, and it was impossible to find the point of exit of the dilated glands at their bases. From this he concluded that, as the papillæ grew in length, they also grew together at their bases, thus closing the mouths of the glands, and this led to a dilatation of the fundi below. This dilatation he believes to be the first step toward malignancy, and Waldeyer agrees with him here.

Granulation tissue ("periacinöse Wucherung") surrounds the cancerous bodies. This is young connective tissue, and, according to Waldeyer, the amount and consistence of this stroma decides whether a tumor is to be of the scirrhous or medullary type. Waldeyer's descriptions of the development of carcinoma from the gastric glands are plain, indeed, but his illustrations fail to show the connection between the glands and the tumor in the submucosa.

As an illustration of the development of carcinoma from the glands I offer the following case:

CASE VII.—*Mixed tumor. "Cylinder-cancroid" and carcinoma. Ring-shaped, large, semisolid, ulcerated tumor in pyloric end and the neighboring part of the duodenum. Some contraction of pylorus without dilatation of the stomach. The tumor started in the glands of the mucosa, which sends extensions down into the muscularis mucosæ. Similar tumors of the lymph-glands of the lesser curvature of the stomach; cylinder-cancroid of the liver. Miliary carcinoma of the peritoneum. Croupous pneumonia of the middle lobe of the left lung. Bronchiectatic cavities of the basal lobe of the left lung.*

Henriette Jörgensen, forty-six years old, married. Autopsy, March 5, 1872, seventeen hours after death. The abdominal cavity contains 2.5 liters of a clear, pale, serous fluid. The pylorus is pulled down and lies below the right lobe of the liver, surrounded by nodular tumors. The stomach is not dilated; it holds 520 c.c. The form is normal as far as to the pyloric end, which is contracted and does not admit the tip of a finger. The constriction is due to an ulcerated tumor which is 10 cm. wide and reaches completely around the pyloric end. The tumor ends toward the fundus as a pronounced infiltrated, wave-shaped ridge. It extends over the pyloric sphincter for 2 cm. into the duodenum as a flat, grayish-white, soft infiltration of the mucosa.

Cross-section at the pylorus shows the serosa on the outside, and is unchanged except at the lesser curvature, where there is found a tumor mass, 1 to 2 cm. in thickness; the muscularis is hypertrophied, being 5 to 10 mm. thick, and penetrated by large septum extending into it from the mucosa; in the submucosa inside of the muscularis is a homogeneous, soft, white tumor which in cross-section simulates the brain substance. From the cut surface a purulent fluid, consisting of cylindric cells, can be expressed. The mucosa of the fundus has undergone postmortem softening. In the gastrohepatic ligament occur small, firm, white nodules. Everywhere around the pylorus are tumors varying in size from that of a hempseed to a walnut. One of the retroperitoneal glands has been changed into a soft, walnut-sized tumor.

At the upper right edge of the right lobe of the liver is found a round, nodular tumor as large as a walnut. Besides this tumor there occur a nodule as large as a hempseed and another as large as a pea in the left and right lobes of the liver respectively.

Tumors varying in size from a millet-seed to that of a pea are found in the utero-vesicular fossa and in the pouch of Douglas. These rather firm tumors are fastened to the other tissues by a broad base. They are often pigmented, and have a papillomatous surface. The other organs are unchanged.

Microscopically, the mucosa is seen to extend 1 cm. up over the edge of the ulcer. The edge is 1 to 2 cm. thick, and consists of a ½ to 1 cm. thick layer of carcinomatous cells, and below this the thickened muscularis, which is penetrated by white septa. Underneath the muscularis, in the neighborhood of the lesser omentum, is found a tumor mass 2 cm. thick, which incloses a number of enlarged lymph-glands. The mucosa at the edge of the ulcer is not thickened; on its surface occur naked villi which are not enlarged; no exits for the gastric glands are visible, and the mucosa consists of a uniform mass of connective tissue containing scattered indifferent cells. In the deeper layers of the mucosa are glands occurring as distinct groups of acini. A few of these are rather winding in their course, and have slightly irregular sides. In the muscularis mucosæ appear alveoli, some of which are regular and lined with cylindric cells; others are irregular, often with long, narrow cavities, which are filled with round polymorphous or cubic cells, 12 micra large, and having a nucleus 6 micra in size. These cavities—Waldeyer's carcinomatous bodies—are clearly seen to be in direct connection with, and to originate in, the glands of the mucosa (See Plate I, Fig. 2, 5). The tumor in the submucosa consists of a connective-tissue stroma containing alveoli lined with cylindric cells. These alveoli are often arranged in groups resembling the grapelike glands of the mucosa. In the white septa between the muscular bundles alveoli similar to those of the tumor occur. In the lymph-glands is found a delicate, often pronouncedly degenerated, stroma, surrounding large groups of alveoli, most of which are lined with cylindric cells, but some are filled with irregular cell forms. Large parts of the lymph-glands consist of cheesy masses in which the outlines of regularly arranged cylindric cells can be distinguished in a fatty, granular detritus.

The tumors in the liver are cylindric carcinomata having a scant stroma and large alveoli.

As is seen in Fig. 2, Plate I, the connection between the gastric glands and the carcinoma is definite. The papillæ at the surface of the mucosa are seen to be of normal height; their epithelial covering is absent. The gland openings are not visible, and the upper layer of the mucosa appears as a uniform layer of connective tissue containing fibers and nuclei partly arranged along the long axes of the villi.

It was pictures of this type which brought Cornil to the conclusion that the mouths of the gastric glands were closed by the growing together of the villi at the bases. I consider this conclusion rather hasty, since the identical picture can be seen in the upper layer of the mucosa in cases in which the epithelium is lacking from the villi and the openings of the glands; the openings become unrecognizable in such cases, but may be wide open for all that. That such is the case I have often observed while examining the mucosa of parts of the stomach distant from the malignant growth, as, for instance, in the fundus, when the cancer was located at the pylorus. Whether the epithelium in such cases was lost prior to death through catarrh of the stomach or was lost by softening after death, one gets the impression of the upper part of the mucosa being a homogeneous mass with closed gland mouths. But this does not mean that they are actually grown together, especially since the fundi below are of normal appearance, neither filled with cells and secretion nor dilated, hence without any signs of anything preventing their contents from being emptied. Deeper in the mucosa (See Plate I, Fig. 2) the glands (3) appear as groups of acini cut across. These are not dilated, but here and there they are slightly irregular in form. This is especially the case in one place (at 5, *a*), where they break through the muscularis to the mucosa; here occurs a group of irregular acini, from which a string of cancer-cells penetrate into the muscularis mucosæ (5, *a*). This string is at first narrow, being only two cells wide, but a little deeper where it enters the submucosa; branches are given off at the sides, forming elongated groups of cancer bodies (5, *b*). The entire group of cancerous bodies and glands correspond nicely to Waldeyer's description; the group has the shape of an hour-glass, the upper, wider portion being formed by the irregular acini, the middle part by the narrow stalk in the muscularis mucosæ, and the lower, wider portion (5, *b*) by a larger group of cancerous tissue in the submucosa. A little to the left of the figure (at 5, *c*) is seen another penetration; in the narrow septum in the muscularis occurs a canal cut across, lined with regularly placed cells; below this is seen both a large cancerous body, consisting of round-cells, and a group of alveoli similar to the irregular acini of a gland, having regular secreting cells in one of the acini. The connection between these cancerous masses and glands above is not shown in the figure, but such a connection was without doubt present. It is, as a rule, very seldom, that the origin from the glands is shown by a single section as plainly as at 5, *a*. In such a case the cut must pass straight in the direction of the penetrating cells, for if it falls in any angle of this, isolated groups of alveoli appear; when, however, one has once discovered the direct connection between glands and the carcinomatous tissue underneath, it is easy to follow, by successive sections, the relationship of the malignant cells, although the sections may run diagonally to the stalk.

RETROGRESSIVE PROCESSES AND ULCERATION IN CANCER OF THE STOMACH

On the whole, the retrogressive processes of carcinoma of the stomach are similar to those of carcinomata anywhere in the body. When cancerous tissue has reached a standstill, there occurs, after a certain period, different for the various types, and, as a rule, shorter for the softer than the more solid forms, fatty degeneration, whereby both the stroma and the alveoli are changed into a granular detritus. In carcinoma of the stomach, and especially in the softer forms, as medullary carcinomata, large portions of tissue may die at once, thus producing greater or smaller areas of gangrene in the tumor.

(*A*) *Gangrene.*—Gangrene of larger portions of malignant tumors is not a rare occurrence. Prus* noted it, and believed it might lead to a cure. Köhler states that the entire tumor might become gangrenous, and the process may not only extend to the serous coat of the stomach, but might affect the adherent neighboring organs as well. Lebert* once observed a gangrenous slough adherent to the liver. Later observers, though reporting large series of cases, do not put any special emphasis on gangrenous destruction. For this reason I shall describe a case of this type. In this case carcinoma was suspected during life, since the vomited material had a pronounced fetid odor.

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* *Loc. cit.*, p. 282.

CASE VIII.—*Medullary carcinoma (medium-sized cells). A soft ulcerated tumor in the pyloric end. This is adherent to a tumor as large as a child's head between the pylorus and the transverse colon. The center of the large tumor is gangrenous, and a large cavity has been formed which communicates with the stomach through the bottom of an ulcer. Carcinomatous lymph-glands along the lesser curvature. Marantic thrombi of both crural veins.*

Marie Richter, fifty-nine, married. Autopsy July 9, 1873, thirty-six hours after death. There is no fluid in the peritoneal cavity. Between the transverse colon and the stomach is a tumor as large as a child's head. It is found in the left hypochondrium and the iliac fossa, and it is movable against the posterior abdominal wall, but adherent to the stomach and the colon. The stomach contains a thin, grayish fluid in which are whitish-gray shreds and clumps of degenerated tissue. In the posterior lower wall of the pylorus is a round ulcer, 10 cm. in diameter. This has a gray spotted, soft, uneven raised edge. The floor forms the entrance to a cavity as large as a fist. This has been produced by gangrene in the large tumor, and is filled with a gray, stinking fluid containing large necrotic masses of the malignant tissue. The non-gangrenous part of the tumor has a grayish-white cut surface, from which great quantities of purulent fluid can be expressed. This fluid contains polymorphous cells, part of which are cylindric and part round or angular, with round or oval nuclei. The surface of the tumor is covered by the omentum, and here are found numerous soft white nodules varying in size from that of a pea to a nut. There are metastatic tumors along the lesser curvature. No other metastatic growths are present.

(*B*) *Ulceration.*—Gangrene of smaller portions of the tumors is often associated with ulceration, so that there is found in the rapidly growing tumors a combination of gangrene and molecular necrosis. (Rokitansky and Dittrich were the first to write detailed descriptions of ulceration in carcinoma of the stomach.) In the firmer types, as the diffuse scirrhous and alveolar carcinomata, retrogressive processes occur from the surface inward and take place so evenly that the stomach-wall appears ground away. Dittrich believes this might be due to the peristaltic movements of the organ, whereby the tumor is rubbed against the food or the opposite wall.

There are no statistics giving the frequency of ulceration for the various types of carcinomata. The statistics available give only the relative proportions of ulceration in carcinoma as a whole. All reports are vague regarding the frequency of ulceration in any individual class of cancers. Köhler, who grouped together the figures given by Lebert, Valleix, and Dittrich, found ulceration present in 69 of 115 cases, or 60 per cent., of carcinomata of the stomach. Waldeyer found 32 cases, which he divided as follows: 11 scirrhous, 5 medullary, 3 colloid, and 13 ulcerated. It cannot be possible that more than half of Waldeyer's cases were non-ulcerative, and just what he means by 13 ulcerative cases is hard to say. Twenty-eight of my 32 cases were complicated by ulcers, and only 4 tumors—2 of diffuse scirrhous, 1 of cylindric celled, and 1 of diffuse alveolar carcinoma—were covered with intact mucous membrane, which never appeared quite normal, and was at times more or less infiltrated with carcinomatous cells. There are, of course, all possible varieties of malignant ulcers, from the most superficial ones to a very wide and deep loss of substance, and to place an arbitrary limit on it, as has been attempted by Köhler and Waldeyer, is impossible.

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* *Loc. cit.*, p. 483.

The ulceration begins in the mucosa, which either sloughs off in large flakes or disappears in very small particles. As far as I can make out, from a study of younger tumors, the degeneration of the mucosa is always due to a preceding cancerous infiltration, hence it is the carcinomatous tissue which becomes necrotic. I have never observed that any large part of the non-cancerous mucosa has sloughed. Destruction of the malignant tissue in the submucosa and the muscular layer is often accompanied with small hemorrhages. The blood when changed by the gastric juice appears like coffee-grounds in the vomitus. The degenerated tissue is also infiltrated by this blood, so that the floor of the ulcer often has a grayish-black appearance. The destruction of tissue does not, as a rule, take place evenly over the entire surface, but often penetrates into the depths of the tissues, forming irregular cavities.

While destruction of tissue takes place in some places, new cancerous projections grow out in others, thus adding still more to the irregularity of the ulcer. One remarkable feature of these carcinomatous ulcers is that there is rarely any disagreeable odor from them. Neither the vomited masses nor the gas forced up from the stomach is especially odorous. This is apparently due to the action of the gastric juice, since it has lately been shown to have a deodorizing effect on cancers in other parts of the body. As far as the gastric juice goes, it is assumed to have some effect on the ulcerating surface which is not protected by the mucosa. It seems to dissolve the superficial layers of the surface it touches, and thus facilitates the spreading of the ulcer. In a few instances I have observed what appeared to be a dissolving action of the gastric juice on the edge of the penetrated muscularis. I found, for instance (Case XXVIII), that the infiltrated muscular edge of the ulcer was smooth. Microscopically, the carcinomatous tissue and the muscle-fibers did not show fatty degeneration, as is usually the case in carcinomatous ulcers, but they appeared unchanged almost to the very edge of the ulcer. There was only a thin layer (0.5 mm. at the very edge) where the malignant tissue, as well as the muscle-fibers, was changed to a finely granular mass without fat-globules. I believe it possible for this finely granular degeneration to be due to the corroding influence of the gastric juice. This is made more plausible by the fact that such a finely granular edge has been observed* in the peptic ulcers, and here it is recognized as due to the action of gastric juice.

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* Klebs: *Loc. cit.*, 1. Lieferung, p. 182.

When the ulcer has passed through the muscularis, its bottom often is found to be smooth, firm, and of a white color, as if it consisted of connective tissue. But this appearance is most frequently due to a firmer carcinomatous development in the serosa. I found only a single instance where the floor was composed entirely of connective tissue, but even here the edge was made of growing carcinomatous tissue. It appears as if ulcers clean themselves by throwing off cancerous masses. The clean appearance produced by this has led to the belief, held by some, that carcinoma is curable.

Dittrich* especially has advanced this view. He failed to find instances of this in the literature, yet he believes it possible, although the bottom of the ulcer was cleaned only in parts and carcinomatous growths were still present. He admits of having seen only a single instance of healed carcinoma. This occurred in a woman, sixty years old, brought in dying of pneumonia. On the lesser curvature of the stomach was found a wide scar, 3 to 4 x 1 cm., firm, fibrous. Unfortunately, this case is not at all suited to prove his claim, partly because a clinical history is missing, and, what is of much greater importance, there were absolutely no signs of metastatic growths in the liver or the lymph-glands. It was without doubt the scar of a peptic ulcer. Lebert,† too, believes cancer curable, and bases his belief on three cases, but none of them prove anything, since cancerous tissue was present in the edges of them all. Förster does not believe that healing is possible, and does not regard Dittrich's case as convincing. He firmly asserts that carcinoma of the stomach is always fatal. I have seen nothing in the literature or at autopsies which would lead me to believe in the curability of carcinoma of the stomach.

VARIETIES OF CANCER OF THE STOMACH

SCIRRHUS

It is difficult to define scirrhus histologically, because, on the one side, it shades into hypertrophy of the connective tissue, and, on the other, it is more or less closely allied to the softer varieties of carcinoma. For this reason histologists do not consider it an individual form, and, from Müller's time on, it has been classified with the carcinomata as a subvariety. It is often impossible to separate it from the other forms, and the only reason for not giving up its independence entirely is that clinically it has been known from earlier times to be less malignant, to grow slower, and to be less prone to metastases than the softer types—the medullary carcinomata. In pathologic as well as clinical descriptions scirrhus appears as a main variety of cancer on a par with carcinoma, "cylinder-cancroid," and alveolar cancers ("Carcinom, Cylindercancroid, og Alveolarkräft"), but individual writers have used the term "scirrhus" in part of their cases without stating where they put the dividing-line between scirrhous and medullary carcinomata. Since the line of division necessarily had to be arbitrarily placed, it is readily explained why its frequency in relation to other tumors varied so vastly. Rokitansky considered it the most frequent of carcinomata of the stomach. So did Brinton,* who gives a frequency of 72 per cent. In 182 cases he found 130 instances of scirrhous, 32 of medullary, 17 of colloid, 3 of melanotic, and 1 of villous cancer. Hannover† and Förster‡ found the medullary carcinomata far more frequent than the scirrhous type in the stomach. I have classified as scirrhus those firm tumors where cancer juice could not be expressed from the cut surface, and have come to agree with the last-mentioned writers that scirrhous carcinomata are less frequent than the softer forms, since only 5 of my 29 cases were of this type. Structurally, there is no special difference between scirrhous carcinoma of the stomach and that of other organs, *e. g.*, the mammary glands. On the whole, the connective tissue is present in an overwhelming proportion. Thus I found varieties corresponding to Billroth's § connective-tissue cancers. Other forms appear as carcinoma with hypertrophy of the connective-tissue bundles. These develop at the expense of the alveoli, the cells of which atrophy and undergo granular degeneration in proportion as their space is encroached upon by the developing stroma (Rindfleish‖ and Lücke**).

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* *Ibid.*, p. 15.

† *Loc. cit.*, p. 474.

Finally, there are types with the usual alveolar structure and without a pronounced hypertrophy of the connective-tissue stroma, in which the alveoli are very small, and it is apparently the size of these which makes the firm consistence of the tumor. The last-mentioned type forms the connecting link with the ordinary carcinoma. I failed to find a single instance of scirrhous carcinoma the structure of which suggested glandular structure or adenoma. The alveoli were always evenly distributed in the stroma, were often of equal size, and either oblong or rod-shaped.

As regards development, I failed to find any proof of Waldeyer's theory. The cancer did not originate in the gastric glands. These are either unchanged (never dilated), or have undergone atrophy, being suffocated between the protruding masses of the tumor.

In order to elucidate the structure and development I shall give a few examples of the types of scirrhous carcinoma:

(*a*) *Diffuse, Flat, Non-ulcerative Forms.*—These often occupy the entire stomach, which in such cases is uniformly decreased in size and has firm, stiff, thick walls. According to Klebs, the thickening is mostly due to hypertrophy of the muscular layer. I was unable to verify this, since I found the submucosa 4.2 mm. and the muscularis 4 mm. thick. These tumors are strictly limited to the stomach, and always end at the pylorus. When they do not cover the entire stomach, they most frequently, if not always, occupy the pyloric end. In these cases the thickening is most pronounced at the sphincter, where it abruptly ceases, while at the other end it gradually disappears in the wall of the fundus. Inside the stomach is usually uneven, with thick, flat folds or nodules over the infiltrated portion. Rarely it may be smooth. The mucosa is fixed and thickened. At first it is movable and of normal appearance, its outlines distinctly separated from the underlying tumor mass, but later it becomes firm and of whitish appearance; its borders disappear, and it is usually changed into a cancerous mass, or, what is very rare, it may disappear as though ground off. This is more marked over the protruding nodules. In place of the submucosa is found a white, cartilaginous mass, 3 to 6 mm. thick, which looks like connective tissue. From this septa penetrate the muscularis. Förster held that these always consist entirely of connective tissue. In my cases the tissue was always that found in the tumor of the submucosa. At times a similar infiltration is present in the subserous connective tissue. On the peritoneum there often occur pinhead-sized metastatic growths. Less frequently the peritoneum may be diffusely thickened, the thickenings consisting either of cancerous cells or of simple granulation tissue. The large omentum is retracted and thickened, and also studded with granules. In such cases ascites is often present. Besides the metastasis of the peritoneum, the neighboring lymph-glands are at times involved, but metastasis in other organs is rare.

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* Diseases of the Stomach, London, 1864, p. 231.

† Hvad er Cancer, Copenhagen, 1843, p. 60. ‡ *Loc. cit.*, p. 73.

§ Die allgemeine chirurgische Pathologie und Therapie, Berlin, 1868, p. 724.

‖ Lehrbuch der pathol. Gewebslehre, Leipsic, p. 103.

** Handbuch der speciellen und allgemeiner Chirurgie von Pitha und Billroth, Bd. ii, p. 226.

Two of my cases of diffuse scirrhous carcinoma were accompanied by cancerous infiltration of the cecum and the rectum, with involvement of the surrounding connective tissue.

CASE IX. *Scirrhus. Diffuse infiltration of the stomach, cecum, rectum, and perirectal connective tissue. Stenosis of the rectum and the colon. Miliary metastasis of the peritoneum and retraction of the omentum. Ascites. Enterotomy, followed by diffuse peritonitis.*

Hans Jensen, fifty-two, blacksmith. Autopsy thirty-six hours after death. The body is well preserved. In the abdominal cavity occurs 1000 c.c. of a thin, cloudy, semipurulent fluid. On the peritoneal surface of the anterior abdominal wall and of the intestines, especially the colon, occur scattered, pinhead-sized, gray, semisolid nodules, which in places become confluent, to form larger infiltrated plaques. The omentum is retracted, toughened, and contains multiple millet-sized nodules, some of which are yellow and consist of fat, others grayish, and are metastatic growths. The stomach is of normal shape, but about half normal size. It is uniformly resistant. On its serous surface occur a few small nodules, the remaining surface being smooth. The organ contains a shiny, grayish substance. Its wall is diffusely thickened from the cardia to the pyloric sphincter, measuring 1½ cm. in thickness in the pyloric end and 1 cm. in the fundus. The condition of the individual layers is as follows: The serosa is not pronouncedly thickened, but nontransparent and adherent to the muscularis, which is 7 mm. thick in the pyloric end and 4 to 5 mm. in the fundus. It has its usual grayish, transparent appearance, but is everywhere penetrated by broad white septa. The submucosa is changed into a layer of a semisolid tumorous tissue, 3 to 5 mm. thick, which cannot be separated from the mucosa. This is also thickened (3 to 4 mm.), and is movable only in a few places, where the thickening of the wall is at the minimum. The cut surface of the tumor mass in the submucosa and the mucosa appears grayish white, semisolid, and of uniform consistence. Only a small amount of clear fluid can be expressed from the tissue. The inside of the stomach is uneven and wavy, produced either by markedly thickened longitudinal folds or by flat round tumors, 1 to 2 cm. wide and 2 to 3 cm. in height, most numerous at the pylorus. Their surface is rough and slightly eroded. The mucosa is light gray in color and opaque. Only in a few places on the tumors and the longitudinal folds occur spots of a light rose-red color, due to injected capillaries. There is no pronounced stenosis of the cardia or of the pylorus. The duodenum and the small intestines are unchanged, except for a small amount of pigment in the mucosa of the lower part of the ileum. The mucosa is not thickened.

The cecum and the entire colon have undergone changes similar to those of the stomach. Their walls are from 5 to 10 mm. in thickness. There is not much retraction, but the lumen is narrowed on account of the thickened walls. The serosa is unchanged, but the muscularis is from 1½ to 3 mm. in thickness, and it is penetrated by white septa. Inside of the muscularis is a fleshy layer of uniform consistence, 5 to 7 mm. in thickness. The inner surface of the intestines is roughened and studded with semispheric or flat, smooth, grayish or light-red nodules, varying in size from that of a pea to a nut. These are semisolid, and fixed to the underlying tissue. In one place, at the duodenal flexure of the colon, these tumors are so large and numerous as to produce a constriction of the lumen. This stricture admits a No. 22 French catheter with difficulty. The mucosa cannot be distinguished from the underlying tumor mass. The cut surface of the larger tumors is smooth and of a grayish color, similar to the cut surface of the tumors in the stomach. It is transparent and of a uniformly fleshy appearance. A small amount of a nearly clear fluid can be expressed as in the stomach. This is found to contain a few blood-corpuscles and spindle-shaped cells. The wall of the sigmoid flexure is unchanged, but the entire rectum is thickened, most marked in a portion about 6 cm. long, which commences 3 to 4 cm. above the anus. Here also occur round, firm nodules, and the lumen is constricted to such a degree that it admits only the tip of a finger. The connective tissue around the rectum is changed into a grayish-white, fibrous mass. The rest of the organs are normal.

The white fibrous masses of the submucosa, the stomach, colon, and rectum, consist of a finely fibrillar connective tissue containing numerous small round-cells from 3 to 6 micra in diameter. There also occur a few scattered cells having oblong, nearly rod-shaped nuclei. Besides these, large masses of larger round-cells with granular cytoplasm and with large round nuclei can be seen in certain parts. These may occur singly, scattered among a fibrillar tissue, or may be found in chains or rows among heavier bundles of connective tissue. Alveoli do not occur, and these large cells are so closely packed among the connective tissue that they cannot be shelled out. Finally, a large part of the tumors consist of adult connective tissue with elongated or star-shaped connective-tissue cells, and without both the small round-cells and the large cells just described. The mucosa is absent from the larger tumors of the stomach and the cecum. But on the less prominent parts of the stomach a line may be seen (in hardened preparations) which indicates the division between the mucosa and the tumor. In such places the new-growth is seen to be forcing itself from below toward the surface, since the muscularis mucosæ is first pushed aside, and then the growth extends up between the fundi of the glands. These decrease in number, become scattered, and finally disappear, the gland-cells becoming changed into a finely granular débris. Signs indicating that the glands take an active part, such as dilatation of their fundi or divisions of the gland-cells, cannot be found. On the surface of such portions the villi are still intact, of normal size, but the epithelial lining is absent between them. Similar changes are found in the mucosa and submucosa of the cecum and the rectum. The bundles of the muscularis are separated by thick septa of the type of tissue found in the submucosa. The nodules on the peritoneum consist of similar tissue.

The tumors in the stomach and in the bowels in this case belong to a variety of scirrhus which is closely related to connective tissue—the "connective-tissue cancer" ("Bindevävskräften"). The tissue was made up of a uniformly fibrillar connective tissue, in which occurred both finer and coarser fibrillæ. Between these occurred small round-cells suggesting an active development, and also larger round-cells, about 12 micra in diameter, and the nuclei of 6 micra. Between these and the small round-cells transitional forms occurred, thus suggesting that the large round-cells developed from the smaller ones. That such is actually the case cannot be definitely proved, and must, therefore, always remain a theory. Here and there the large cells were gathered into rod-shaped groups, thus giving the tissue somewhat of a carcinomatous appearance. It is this type of architecture in a cancer which speaks strongly for Virchow's theory of development, according to which the malignant cells are formed from connective tissue, and it is difficult to believe that all these scattered cells originate from carcinomatous bodies, which must have been the case, according to Waldeyer's ideas. Moreover, the relation of the gastric glands speaks against Waldeyer's theory, because these were atrophied, pressed together, and widely separated by tissue of the same type as that of the tumor in the submucosa.

The further development and retrogressive metamorphosis of tumors of this class are characterized by a disappearance of the granulation cells, which are replaced by numerous fine elastic fibers, among a fibrillar and often finely granular connective tissue, surrounding the partly scattered and partly grouped epithelial cells.

A similar structure, development, and mode of extension took place in the following case:

Case X.—*Scirrhus of the pylorus; flat, diffuse, non-ulcerative infiltration, with retraction of the stomach, especially the pyloric end. Ascites. Scirrhus of cecum and rectum and scirrhous infiltration of the connective tissue of the true pelvis, with stenosis of the rectum. Hypostatic pneumonia of the lower lobe of right lung. Pachymeningitis interna. Chronic pigmented catarrh of the colon.*

Ane Meyer, age seventy, widow. Autopsy June 18, 1872, twenty hours after death. The peritoneal cavity contains 500 c.c. of a clear, serous fluid. On the visceral and parietal layers of peritoneum are found numerous nodules, from millet- to pinhead size, close together, and of grayish color. The stomach is greatly reduced in size, and consists of a sausage-like fundus, 7½ cm. wide and 8 cm. vertically; and of a small, sausage-shaped pyloric end, which is 9 cm. long and 3 to 4 cm. in diameter. It reaches to the left side of the gall-bladder, and is covered by the quadrate lobe of the liver. The stomach holds 160 c.c. The pyloric part of it is firm, rigid, and uniformly constricted. The right end scarcely admits two fingers, while the sphincter end barely admits one. The pyloric wall is markedly thickened, due to a muscular layer, 3 mm. thick, which is penetrated by radiating white septa, and to a white, scar-like substance internal to the muscularis, the cut surface of which yields no juice on scraping; and to a mucous membrane, intact all over, but firmly adherent to the underlying layers. It is smooth, of a yellowish-gray color, and appears normal to the naked eye. In the fundus the mucosa is engorged with blood and contains numerous ecchymoses. It is freely movable and of a normal thickness. The muscularis is unchanged.

The liver is normal. The portion of the cecum next to the ileocecal valve is markedly retracted. Its wall is 4 to 5 mm. thick. The muscularis contains white septa extending into it from the firm, white, thickened connective tissue of the muscularis. The mucosa is adherent to the submucosa. In the large intestine occur large pigmented areas scattered over the mucosa, and at one place the layer is injected and contains minute hemorrhages. The rectum is firm and contracted; its lumen does not admit the tip of a finger. The wall is greatly thickened, the longitudinal layer being 2 mm. in thickness, and the circular fibers forming a layer measuring from 2 to 3 mm. in thickness. The submucosa is not thickened, but sends light, fibrous septa into the muscularis. The mucosa is to a slight extent diffusely pigmented; it is movable and otherwise unchanged. The connective tissue surrounding the rectum and the tissue between the uterus and the rectum is firm, fibrous, and has a reticular cut surface, the meshes of which contain groups of yellow fat-granules or edematous connective tissue. The retroperitoneal lymph-glands form with the surrounding connective tissue a fibrous mass lying around the large vessels in front of the spinal column. Similar changes have taken place among the glands and connective tissue of both inguinal regions.

Microscopically, the mucous membrane of the pylorus is seen to be thickened (1 to 1.5 mm.); the villi are not lengthened. The mouths of the glands cannot be seen, and the cylindric epithelium is lacking, so that the mucosa consists of narrow bundles of connective tissue running perpendicularly to the surface. Between these occur numerous oblong groups of large round-cells with large nuclei (gland-cells). In the deeper layers of the mucosa are seen a few scattered, non-dilated gland fundi. The hypertrophied muscularis mucosæ contains no alveoli. The firm white tumor mass in the submucosa consists of a fibrous, often wavy, connective tissue, richly supplied with elastic fibers, and containing in places a large amount of small round-cells, measuring 12 micra in diameter, with a distinct nucleus, 6 micra in diameter (carcinomatous cells). Between the bundles of the muscularis are found septa of a finely granular connective tissue, rich in elastic fibers. In this tissue occur small groups of individual cells similar to the large round-cells found in the submucosa. The nodules on the peritoneum consist of connective tissue rich in small round-cells. The wall of the cecum has undergone the same changes as that of the stomach. The mucosa of the rectum is markedly thickened (2 mm.). The glands are not dilated, and the muscularis mucosæ is unchanged. The interstitial tissue of the hypertrophied muscularis is increased, and scirrhous tissue occurs in places, as was the case in the stomach. The firm scirrhous tissue in the pouch of Douglas and surrounding the rectum consists of fibrillar, wavy connective tissue, in which occur scattered areas of small round-cells and only a few large round-cells with large nuclei.

It is cases like the above which have led writers to believe that they represent a benign condition of the stomach different from cancer—a theory based more on the structure, lack of metastasis, and absence of retrogressive changes than on the real outcome of the disease. However, as a rule, all attempts made to separate a benign tumor from real cancer have been in vain. This disease has been described under many and varied titles. Andral* called it hypertrophy, but mixed it up with cancer, when he held that ulceration might take place. Burch† commits the same error, and even classifies as hypertrophy cases which produce medullary metastasis in the lymph-glands and the lungs. In spite of the fact that he studied the tumors microscopically, he believes that the solid tumors of the stomach are benign hypertrophy and have no relation to the medullary cancer of the other organs. Snellen,‡ basing his ideas on one case, proposed the name "sclerosis," since there is an increase of connective tissue at the expense of the other tissues. Metastasis did not occur in his case, but retraction was observed. Rokitansky groups all tumors of this structure under "Scirrhous Degeneration of the Stomach-wall." Habershon* reports as "Fibroid Degeneration of the Pylorus" cases in which the tumor consists of fibrous tissue without malignant cells, but he adds that the lymph-glands may be involved, the omentum may become retracted, and ulceration may occur. Brinton† classifies under Cirrhosis ("Cirrhotic Inflammation or Plastic Splenitis") the benign forms, and justly emphasizes the point that they should be free from metastasis. He admits, however, that they have many features suggesting cancer, although he believes in an essential difference between these and cancer which cannot be seen in their structural characteristics.

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* Precis d'anat. pathol. Paris, 1829, vol. ii, p. 58.

† "Ueber Magenkrebs und Hypertrophie der Magenhäute," Zeitschr. f. rationelle Medicin, 1849, vol. viii, p. 249.

‡ Nederl. Lancet, 1855; Constatt Jahrber., 1856, vol. iii, p. 303.

At present it is impossible to decide whether a benign growth, simple localized or diffuse connective-tissue hypertrophy, structurally and morphologically different from cancer, really exists. The histologic diagnosis stumbles on the connective tissue. Lack of metastasis must be the only criterion. It is hardly admissible, with Snellen and Habershon, to place cases with retracted omentum in the benign group, since a simple inflammation (chronic peritonitis) does not produce retraction of the omentum. This is a special characteristic of tuberculous and cancerous peritonitis, and occurs only when new formations are found in the omentum. Brinton does not mention the omentum in his "Cirrhosis." If, in the diagnosis of these cases, both structure and metastasis are taken into account, the number of such benign forms would, at any rate, greatly decrease. Personally, I have failed to find a single instance of such tumors.

(*b*) *Circumscribed Ulcerative Forms.*—These are either composed of the kind of tissue described under Case X, or of an ordinary carcinomatous structure with small alveoli and a large amount of connective tissue. The tumors do not, as a rule, reach the size of the medullary carcinomata. Otherwise they are distinguishable from the latter only by their firmer consistence and lack of metastasis.

CASE XI.—*Scirrhus with small alveoli and small cells. A firm circumscribed ulcerated tumor on the lesser curvature at the pylorus. Carcinomatous infiltration of the lymph-glands at the greater curvature. Perforation of the ulcer. Acute generalized peritonitis.*

Andrea Jörgensen, age fifty-six, widow. Autopsy March 9, 1872, twenty-four hours after death. Under the left lobe of the liver, on the anterior surface of the stomach, is an opening 1 cm. in diameter. This leads into the stomach cavity, and part of the stomach-contents has escaped through it, and is seen as brownish-red clumps in the exudate surrounding the opening. The stomach is filled by various food-substances. There is an ulcer, 4.5 cm. long, on the half of the lesser curvature facing the pylorus, and from this extends a round new-growth down over the posterior stomach-wall for 6 cm., and over the anterior surface for 4.5 cm. The floor of the ulcer is smooth, and consists of firm white connective-tissue-like masses with protruding bundles and fibers. The edge of the ulcer is everted, firm, and raised, and a cross-section shows the mucosa, submucosa, and muscularis infiltrated, forming a semisolid, white tumor mass over 1 cm. thick. No juice can be extracted from the cut surface. In the ulcer on the anterior surface is the perforation mentioned; it has smooth, even edges. The cancerous infiltration extends for 1 to 1.5 cm. from the edge of the ulcer out into the surrounding stomach-wall in such a manner that it reaches farthest into the submucosa, extending 1½ cm. into this, whereas it reaches only 7 to 8 mm. into the muscularis. The mucosa of the rest of the stomach is rather pale, opaque, and slightly edematous, otherwise unchanged. The lymph-glands of the greater curvature are transformed into carcinomatous nodules as large as nuts. The retroperitoneal lymph-nodes are not involved. The liver is free from metastatic growths. The other organs are anemic. Microscopically, the mucosa of the stomach is not thickened except at the edge of the ulcer, and the glands appear normal. The tumor mass underneath is 6 mm. thick, and consists of a finely meshed, carcinomatous tissue, in which occur small alveoli (0.03 to 0.15 mm.) containing small round or angular cells, 9 to 12 micra in diameter, with large round or oval nuclei, 6 to 9 micra wide. The lymph-glands contain a malignant tissue consisting of a scant stroma and larger alveoli, holding the same type of cells as those found in the tumor of the stomach. The floor of the ulcer is made up of cancer tissue containing a few alveoli widely separated by connective tissue.

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* "Pathology and Practice," Observations on Diseases of the Abdomen, second edition, 1862.

† *Loc. cit.*, p. 261.

CASE XII.—*Scirrhus; a firm, ring-shaped, ulcerative tumor in the pyloric end, with stenosis of the pylorus and dilatation of the rest of the stomach. Cancerous infiltration of the hepatic lymph-glands, and injection of the lymph-vessels between them. Miliary carcinoma of the peritoneum.*

Hans Paulson, age sixty-one, weaver. Autopsy, November 23, 1872, thirty-six hours after death. The abdominal cavity contains about 100 c.c. of a clear, serous fluid. On the visceral and parietal peritoneum occur scattered gray, small nodules. The omentum is retracted. The stomach hangs perpendicularly, the lesser curvature being slightly retracted, and on it occur irregular white nodules varying in size from that of a hempseed to that of a pea. The hepatoduodenal ligament is retracted, and the transverse colon is fixed to the pylorus by a tumor mass which broke during removal. The stomach, as noted, is markedly dilated; the greater curvature is 45 cm. long; the height is 15 cm., and its capacity, 2100 c.c. It contains a small amount of coagulated milk. The pyloric end is narrowed—its lumen hardly admits one finger. The stenosis is due to a circular tumor extending from the pyloric sphincter about 7 cm. along the lesser curvature. It forms a complete ring close to the pylorus, which on the anterior surface is 2 to 3 cm. wide. The tumor is ulcerated, the bottom of the ulcer being rough and studded with shreds of tissue. The ulcer is surrounded by a wavy, undermined edge, which on cut section is seen to consist of a smooth, firm, whitish tissue from which a small amount of turbid fluid can be extracted. The surrounding mucosa is everywhere softened except in one place on the pyloric end, where a couple of isolated nodules occur. The liver contains a large amount of blood, but is free from carcinoma. The pancreas is firmly adherent to the floor of the ulcer; its tissue is soft, grayish in color, but free from carcinoma. Between the enlarged lymph-glands in the hilum of the liver occur white, injected lymph-vessels filled with small, round, granular cells without nuclei. The spleen is small and soft, but free from metastatic growths. The urinary organs, the mucosa of the intestines, and the brain are unchanged. The retroperitoneal lymph-glands are free from metastasis. Microscopically, the mucosa on the edge of the ulcer is of normal thickness, but consists of connective tissue and cells without signs of glands.

The 3 to 5 mm. thick tumor mass in the submucosa is made up of a fibrillar connective tissue with indistinct, small alveoli, filled with small, granular cells 6 micra in diameter, and without signs of any nuclei. In most places it seems as if the cells had simply infiltrated the connective tissue without any attempt at alveolar formation. The muscularis is 3 to 4 mm. thick, hence slightly thicker than normal; it is penetrated by white septa containing in places oblong groups of cells similar to those of the tumor in the submucosa, and in others, between larger muscular bundles, distinct alveoli.

In the lymph-glands are found large necrotic areas surrounded by infiltrating carcinomatous cells without alveolar arrangement. The nodules on the peritoneum also consisted of cancerous tissue with small cells.

There is nothing unique in the form and size of the cells in scirrhous carcinomata. I found the cells very small and without nuclei in 1 case; in 3 cases the cells were of medium size, 12 to 15 micra, and one single tumor consisted of large cells, 12 to 21 micra, with a nucleus measuring 6 micra across.

On the whole, the tumor mass is not so large as in the softer forms, the average thickness of the mass in the submucosa being 2 to 4 mm. for the scirrhous types, and 9.9 mm. for the medullary carcinomata. The thickness of the muscularis is about the same in all forms, namely, 4 mm. The scirrhous ulcers do not have a tall border, and are not in any way characteristic; neither is the floor, which was villous in one of my cases, smooth in another, and rough and discolored in a third. Twice the ulcer was the size of a palm, and once not quite so large.

Metastasis was found only three times on the peritoneum, and once each in the glands of the lesser curvature, the greater curvature, and the esophagus. The glands never exceeded a nut in size.

Medullary Carcinomata

I have grouped as medullary carcinomata all the more or less soft forms, rich in cancer juice, and containing alveoli filled with round- or polymorphous cells. I found 10 tumors of this type among my 30 cases. There do not occur any statistics by which I might compare this proportion, since the early writers did not keep the "cylindercancroid" and the mixed forms out of their descriptions of carcinomata.

According to Rokitansky, there occur four varieties of medullary carcinoma in the stomach, viz., degeneration of the submucosa, degeneration of the mucosa, villous cancer, and melanotic carcinoma ("carcinoma melanodes"). I have not seen the two last forms. They are very rare. This applies particularly to the melanotic variety. Cruveilhier* gives five illustrations of villous cancer, which is given as one of three main types of carcinoma by Billroth,† who divides malignant growths into epithelial and gland cancer, villous cancer, and connective-tissue cancer. As far as the first two forms go, it must be admitted that it often appears as if they were limited to either the mucosa or the submucosa, but closer inspection always reveals that both layers are involved together—as a rule, the tumor mass is largest in the submucosa. The mucosa is rarely the site of the main mass of the tumor. I only found two cases in which the mucosa was involved alone, as small spots outside of the main growth. The mucosa immediately adjoining the tumor was slightly thickened in only two cases (about 1½ mm. in thickness), but the portion next to the ulcer was always infiltrated. The thickness of the cancerous tissue in the submucosa varied from 1 mm. to 3 cm. The average was 9.9 mm. The muscularis varied in thickness between 1.5 and 8 mm., the average being 4 mm.

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* Anat. pathol., livr. 4, plate 1, Figs. 1, 2.

† Allg. Chir., Pathol. und Therapie, Berlin, 1868, p. 723.

There is nothing characteristic in the size, shape, location, mode of extension, or retrogressive processes which distinguishes these tumors from other malignant growths in the stomach. Attempts at giving characteristic descriptions (Förster*) of the various subvarieties have resulted either in the characteristic features overlapping or, still worse, in absolutely false statements (Klebs†).

On the whole, these tumors are of a more or less soft consistence, but often there occur soft and solid areas in the same growth; the custom is to regard such as medullary carcinomata on a scirrhous base. Often the scirrhous parts observed by the early writers (particularly by Dittrich‡) are, without much doubt, the younger parts of the cancer growth (granulation tissue mixed with the malignant cells). But there are cases in which large, acute, medullary tumors spring from the periphery of other older scirrhous ulcers. A fine example of this is Case II, described above, in which a medullary carcinoma as large as a hen's egg had developed from the edge of a scirrhous ulcer at the pylorus and completely occluded the pyloric end. Microscopically, the firm ulcerated tumor consisted of older scirrhous tissue, and the soft part was made up of large alveoli and a scant stroma.

The ulcers develop more rapidly and become larger in the soft carcinomata than in the scirrhous forms. The tumor was ulcerated in every one of my 10 cases. The edges of the ulcers were at times steep and at others perfectly flat. The floors of the ulcers were rough and irregular in five cases; once it was discolored; twice gangrenous, and twice firm and smooth. In one of these the floor consisted of firmer carcinomatous tissue, and in the other it was made by the pancreas. The size of the tumors or ulcers was in three cases 6 cm., and in four 2 to 3 cm. in diameter. Once the tumor surrounded the pylorus in a ring-like fashion. As a rule, the ulcer is dirty and irregular, with everted, rough, and irregular edges. In only one instance did the ulcer simulate the flat, clean ulcers found in certain forms of "cancroids" of the face. This was in Case XXIV (to be described later), where a flat, round ulcer 3 cm. in diameter, having a reddish-gray floor, was located in the pyloric end near the lesser curvature. The floor in this case was formed by the submucosa, which was not thickened, but partially infiltrated with malignant cells. The edge was smooth and firm, formed by a thin layer of the mucosa, which was white in color and about 15 mm. in thickness. It consisted of cancerous tissue. An insignificant, primary, localized affair of this type is rare, and produces death by metastatic growths, which in this case occurred as cancer of the veins and a pronounced carcinoma of the liver.

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* Handbuch der path. Anat., 1863, vol. ii, pp. 74–78.

† *Loc. cit.*, p. 192. There he states that medullary carcinomata in the pyloric end never affect the sphincter, and that they do not encircle the pylorus. In my few cases the valve was completely destroyed twice in 8 cases; in some cases the tumor was circular. Förster also mentions circular tumors.

‡ Prag. Vierteljahresschr., 1848, p. 12.

(*a*) *The Cells.*—In 5 cases the cells were of medium size, measuring 12 to 15 micra in diameter, with nuclei 6 micra wide. In the remaining 5 cases the cells were large, 20 to 30 micra, and their nuclei were 12 to 18 micra in diameter. The size of the cells in my last 5 cases corresponds to that found by Lebert,* who measured the cells in 9 of his cases and found the diameter to vary between 15 and 30 micra, and that of their nuclei to be between 7.5 and 12 micra.

Klebs † is, of course, right when he states that these granular, irregular cells look like the cells of the gastric glands ("die Labzellen"), but this is nothing peculiar for carcinomata of the stomach. I have been unable to follow the minute changes in the gastric glands, and to observe the relation of these to the carcinoma. I do not understand how Waldeyer ‡ can advance the theory that the malignant cells develop from one ("die Hauptzellen") of the two main types of cells described in the gastric glands by Heidenhain.§ He carried on his investigations in animals in which the almost fresh stomach was put into hardening fluid. The human stomach, on the other hand, is perhaps the place where post-mortem softening first set in, even when it is healthy and contains but little food, and the stomach is not put into hardening fluid before many hours after death. In addition to this the cancerous ulcer doubtlessly aids the process of decomposition, and even where there is no ulcer, the catarrh so frequently associated with the cancer greatly confuses the distinct picture of the glands needed for the recognition of the minute changes observed by Heidenhain in animals.||

The size of the cells bears no relationship to the consistence of the tumor. The tumor was soft 3 times and semisolid in 2 of the 5 cases of medium-sized cells described above. Precisely the same condition existed in the 5 large-celled tumors. It might be supposed that large-celled tumors were less apt to produce metastasis, being analogous to the squamous-celled forms, the larger cells finding it more difficult to enter

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* *Loc. cit.*, p. 480.

† Handbuch der pathol. Anat., Berlin, 1868, vol. i, p. 192.

‡ *Loc. cit.*, p. 19.

§ Archiv f. mikroskopische Anat., 1870, vol. vi, p. 368.

|| My microscopic examinations of cancer of the stomach have been made with preparations hardened in chromic acid. On hardening in strong alcohol the pictures do not become so clear, and it is not so easy to cut thin sections as in hardening in chromic acid. The hardening did not come out equally well in all cases, and it has not always been possible to point out the cause of this. I have noticed one thing which hinders hardening, namely, when the mucous membrane, especially of an empty stomach, is covered with a layer of viscid mucus which extends down into the openings of the glands, forming a viscid adherent layer, so that it cannot be removed by gentle streams of water. Even a strong stream may not be sufficient at the same time, as it removes the epithelium and changes the relative locations of the delicate gland-cells. A layer of mucus like this prevents the chromic acid from penetrating into the mucous membrane as rapidly as is necessary in order that the gland-cells may not become too indistinct. This condition, in conjunction with the rapid decomposition of the mucous membrane after death, renders the examination difficult.

The sections I have made partly free hand, partly by means of embedding in a mixture of equal parts of wax and olive oil. This mass is preferable to the mixture of gelatin and glycerin, because it cuts uniformly and can be removed from the sections without difficulty.

the lymph-stream and be transported. This does not prove to be the case. Metastasis into the lymph-glands and to the peritoneum is evenly distributed between the small-celled and the large-celled groups, and, as far as the liver goes, it was involved three times in the large-celled tumors and only twice in the other.

(*b*) *The Alveoli.*—These vary greatly in size, hence are not at all typical. As far as their grouping goes, half of the tumors contain alveoli uniformly distributed, and in the other half the alveoli were arranged in groups, thus having a similarity to the adenomata.

I was able to trace the development of the growth in five cases from the winding dilated glands in the mucosa at the edge of the ulcer, but this origin did not correspond to the adenomatous appearance of the tumor tissue. Since this mode of development was observed twice where the malignant tissue consisted of scattered alveoli, or the usual carcinomatous appearance, I cite the following case as an example:

CASE XIII.—*Medullary carcinoma on scirrhous base in the pyloric end. It is semisolid, ulcerated, and forms an incomplete ring around the pylorus. Soft nodule at edge. Some degree of stenosis at the pylorus. No dilatation of the rest of the organ. Carcinomatous lymph-glands of the lesser curvature.*

Karl Strey, age seventy-five, carpenter. Autopsy November 29, 1871, twenty-four hours after death. There is a narrowing of the pyloric end of the stomach, which admits only the little finger. This is caused by a tumor extending from the normal pyloric sphincter 7 cm. into the stomach. The tumor surface is ulcerated and covered with long, irregular, injected shreds of tissue. The edge of the ulcer is formed by a semisolid tumor mass, 1 to 3 mm. thick, having a white, reticular, cut surface from which a milky fluid can be scraped, which contain medium-sized round or polymorphous cells. The tumor stops at the free border of the pyloric sphincter by forming here a soft, polyp-like mass nearly as large as a walnut.

Microscopically, the mucosa is somewhat thickened, and studded with large, club-shaped villi. The fundi of the glands are dilated, and connected with alveoli in the muscularis mucosæ, which are filled with round- and polymorphous cells as large as 15 micra in diameter, containing nuclei 6 micra in diameter. In the submucosa occurs a semisolid, whitish-gray layer of malignant tissue, from 0.5 to 1 cm. in thickness. This has a thick granular stroma and medium-sized alveoli, uniformly distributed, and containing the same type of cells as the alveoli of the muscularis mucosæ.

while the gelatin mass is elastic, consequently does not cut uniformly, and is removed with difficulty without tearing the section. It has been stated that it is not necessary to remove the gelatin mass from the section, but this is of no advantage when the section in the gelatin is irregular and of unequal thickness. In order to stain the sections I have used indigo, carmin, fuchsin, and Berlin-blue, dissolved according to the directions given by Frey. I have not found the last three to possess any advantages over the carmin. For the examination of cancer in the vagus nerves I have used osmic acid, which stains nerve-fibers, cancer-cells, and connective-tissue fibers so that the difference between them is not much more distinct than in preparations treated with carmin. The lymph-vessels filled with cancer I treated with chlorid of gold and solution of nitrate of silver, in order to study the relation of the endothelial cells to the cancer-cells. I did not succeed in rendering the endothelial cells visible, which is to be expected only with quite fresh material. My injections with mixtures like Beale's blue failed, as well as injections into the tissues in order to fill the lymph-vessels. Without special apparatus and good assistance it is hardly possible to fill vessels that are so difficult of access as the branches of the superior celiac artery, while the organs are *in situ*, and when one does not wish to inject large parts of the body; I treated the last with carmin, but did not succeed. I did not inject with blue-mass because the face then assumes a hideous appearance. To fill the vessels of the stomach after it is taken out of the body is extremely difficult, on account of the torn vessels at the cardiac end, and, as stated, I did not succeed in injecting the tumors.

In the other half of my cases it was impossible to find any connection between the glands and the carcinomatous bodies. The glands in the mucosa at the edge of the ulcer were unchanged in four of the five cases and atrophied in the fifth. The extension of the malignant cells from the submucosa could readily be traced through the muscularis, and in between the glands in the deeper layers of the mucosa. The following case serves as an example of this:

CASE XIV.—*Medullary carcinoma in the pyloric end; ulcerated; stenosis of the pylorus with dilatation of the rest of the organ; multiple carcinomatous nodules of the liver; miliary carcinomatosis of the peritoneum; ascites; medullary carcinoma of the hepatic lymph-glands, with compression of the bile-passages; icterus; granular degeneration of the myocardium; bronchitis.*

August Lange, age fifty-six, tanner. Autopsy six hours after death. The stomach lies entirely on the left of the spinal column. The pyloric end forms a prominent, firm, nodular tumor, situated slightly below and to the left of the suspensory ligament of the liver. The fundus and the body of the stomach form an elliptic sac placed vertically. It is 20 cm. long, 14 cm. wide, and holds 2220 c.c. The content is a grayish-green, slate-like, turbid mass. The mucosa of the fundus and the corpus is macerated. The pyloric end is considerably stenosed—its lumen barely admits one finger. A ring-shaped tumor, 9 cm. wide, occurs on the anterior wall. The tumor has reached its greatest development on the anterior wall, which is the primary site, and here is found an ulcer, 6 cm. wide, having an uneven, roughened floor and an everted, soft edge. The rest of the tumor is covered with the mucosa, and is separated by a rim from the healthy part of the stomach. The liver is of normal size, and contains numerous small firm nodules having a necrotic center.

Microscopic investigation shows that the mucosa on the edge of the ulcer is slightly thickened (1 mm.), the glands normal, the fundi being neither wavy nor dilated. In the muscularis mucosæ occur small round or oblong alveoli filled with round or slightly angular cells, 12 micra in diameter, having round nuclei about 6 micra in diameter. Groups of cells of the same type are found scattered in the connective tissue at the base of the glands, and extend a short way up between the fundi of these without the glands themselves showing any change of form or their cells differing in any way from the gland-cells of other parts of the stomach. The membrana propria is also intact. A part of the submucosa, 7 to 8 cm. in diameter, is changed into a whitish, gray, soft tumor mass, 5 mm. in thickness. This consists of groups of alveoli and scattered cancer-cells surrounded by a stroma consisting partly of adult and partly of young connective tissue. The muscularis is increased in thickness to 5 to 6 mm. in an area 7 to 8 cm. wide. It is penetrated by septa and strings of the same type of malignant tissue as that of the submucosa.

By observing cases like this one is tempted to agree with Rokitansky, who believes that medullary carcinomata originate in the submucous connective tissue, and from there extend into the mucosa, down among the muscle-bundles, and into the serosa. This hypothesis about the development of malignant cells corresponds to Virchow's notions, and must not be considered entirely gainsaid in spite of Cornil's and Waldeyer's researches. However, since in nearly all cases the information gained about the development of the malignant growths must be secured from studies of the edge of old ulcers, it is not impossible to suppose that the cancer-cells did develop from the glands and simply grew fastest in the submucosa, and finally grew up into the sound mucosa covering the tumor. From my own investigations along this line I cannot absolutely agree with Waldeyer's theory that all the carcinomata spring from the gastric glands.

Metastasis is far more frequent in the medullary than in the scirrhous carcinomata. In my 10 cases the lymph-glands around the stomach were infiltrated in every instance. The retroperitoneal glands were carcinomatous twice, the esophageal glands twice, metastatic growth occurred four times in the omentum and the peritoneum, five times in the liver, and once each in the pleura, diaphragm, kidney, thoracic duct, coronary veins, and in the vagus.

CYLINDRIC EPITHELIAL CANCER (*Reinhardt**); EPITHELIOMA CYLINDRACEUM (*Hannover*†)

The structure of this type of tumors corresponds to that of the carcinoma as far as the main tissues go, that is, a vascular stroma and alveoli containing cells are found in both forms. The difference consists in the shape of the cells in the alveoli. In this type of cancer the alveoli are lined with a single or double row of regular cylindric cells, similar in form and appearance to those found in the intestinal mucosa or the intestinal glands. The epithelial cells of the alveoli are often somewhat larger (Reinhardt, p. 4), but may be smaller than the ordinary cylindric cells (Klebs‡). The malignant cells may have two or three nuclei. The alveoli may be arranged in groups like the adenomata, or may occur uniformly scattered in the stroma, as is the case in the soft carcinomata. Frequently the larger alveoli have a centrally placed lumen containing degenerated cylindric cells, nuclei, round-cells, and a homogeneous, transparent colloid mass (E. Wagner§).

The cylindric epithelial cancers were first observed in the stomach by Reinhardt in 1851. He found two cases of ring-shaped tumors at the pylorus, which appeared entirely like the medullary carcinomata, but microscopic investigation showed the alveoli lined with cylindric cells. The similarity of these alveoli to dilated glands cut across in connection with the dilated glands in the mucosa made Reinhardt consider the growth a hypertrophy of the gastric glands, since he could trace the alveoli of the tumor as cylindric sacs emptying on the mucous surface of the stomach. Both his cases had metastases—one in the liver and kidneys, and the other in the retroperitoneal lymph-glands. These secondary tumors were medullary carcinomata, and it is natural that Reinhardt did not dare to call them metastatic growths from the gastric tumor. Yet he states (p. 18) that the connection could hardly be accidental, and that for this reason the growth could not be considered a benign affair. Bidder|| observed a cancer of the pylorus extending into

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* "Ueber die Hypertrophie der Drüsenfollikel der Intestinalschleimhaut," Charité Annalen, 1851, vol. ii, p. 1.

† Epithelioma cylindraceum foliaceum et globosum, Copenhagen, 1865.

‡ *Loc. cit.*, p. 248.

§ Archiv f. physiolog. Heilkunde, 1858, vol. ii, p. 306.

|| Müller's Archiv, 1852, vol. ii, p. 178.

in height. The thickening of the mucosa is due to the presence of narrow villi, 0.6 to 0.9 mm. in height, covered with cylindric epithelium. At the point where the thickened mucosa goes over into the normal mucosa there occur in the deep layer of it, between the ends of the glands, a number of cavities, 5 mm. or so in width, which are lined with cylindric epithelium and are filled with small round-cells and a granular débris. The submucosa is only slightly thickened, but the muscularis is 0.5 cm. in thickness, and it is penetrated with white septa at the edge of the ulcer, but under the center of it occur small, round cavities filled with detritus, in which the outline of regularly arranged cylindric cells can be distinguished. The tumor mass underneath the mucosa and in the muscularis is found to consist of young connective tissue rich in cells, in which are found large irregular cavities which are often winding and sacculated, similar to glands. Their walls are lined with columnar epithelium, and the lumina filled with round or columnar cells, granular detritus, and pieces of cells. The lymph-glands of the lesser curvature are not involved. The thrombus in the portal vein is non-malignant.

This case shows that tumors of this type are not sharply limited, as held by Klebs,* and there is evidently no difference between "cylinder-cancroids" and carcinomata as far as their mode of extension goes. The former, as well as the latter, infiltrate the interstitial tissue between the muscular bundles, and from there advance into the serosa, where, as in this case, they may produce larger, soft tumors, precisely as do the carcinomata.

A special hyperplasia of the mucosa does not always take place, and is apparently not necessarily preliminary to the development of "cylinder-cancroids" (Klebs, *loc. cit.*, p. 189), which, like the carcinomata, by preference begin in the submucosa, as was the case in the following instance:

CASE XVII.—"*Cylinder-cancroid,*" *primary as a small tumor on the posterior wall of the pyloric end. Croupous pneumonia of the inferior lobe of the left lung. Fatty liver. Diffuse thickening of the pia mater.*

Johan Gensman, thirty-nine years old, laborer. He was an habitual drunkard, and entered the hospital on the fifteenth of April, 1873, with symptoms of lobar pneumonia of the right lung. He had never had any stomach trouble, and died from pneumonia on the seventeenth of April.

Autopsy was held twenty-four hours after death. On the posterior wall of the pyloric end of the stomach, 2 cm. from the sphincter, is located a flat tumor, 3 cm. in width and 5 cm. in thickness, which has an ulcer 15 mm. in diameter in its center. The cut surface is white and semisolid. A few drops of a purulent fluid, consisting of columnar cells, can be extracted from it. The surrounding mucosa is somewhat softened, but free from metastasis. The intestinal wall is unchanged. The liver has undergone marked fatty infiltration. It is grayish yellow and free from blood. The spleen and the urinary organs are rather pale, but otherwise unchanged. The pia mater is white in color and diffusely thickened. The rest of the brain is normal.

Microscopic investigation shows the mucosa of the fundus to be unchanged. The glandular epithelium is everywhere intact, even at the mouths of the glands and to the very tops of the villi. This is an unusual thing in the human stomach. The columnar cells at the mouths of the glands are 24 x 9 micra, and contain oval nuclei, 9 to 12 micra in length and 6 to 9 micra wide. The mucosa at the edge of the ulcer is but slightly thickened and without perceptibly enlarged villi. These are covered with columnar epithelium over the entire mucosa, except that toward the tumor the epithelium is gradually filled by fat-granules and becomes lost. The openings of the gland mouths are everywhere visible and normal.

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* Handbuch der pathol. Anat., 1. Lieferung, p. 189.

The muscularis mucosæ is pressed in between groups of granulation cells containing no malignant tissue. There appears to be a connection between the slightly dilated fundi of the mucosa and the large alveoli lined with columnar cells found in the submucosa. In the inner portions of the tumor toward the center occur groups of wavy alveoli lined with columnar cells, both in the muscularis mucosæ and in the deeper layers of the mucosa. A direct relation between the glands of the mucosa and these alveoli cannot be seen, nor is it possible to decide whether the malignant cells have shot up from the tumor of the submucosa or have extended down from the gastric glands. The tumor in the submucosa is 4 to 5 mm. in thickness; it consists of a stroma, rich in small round-cells, with large, irregular cavities lined with columnar cells, and filled with nuclei, pieces of cells, and granular débris. The columnar cells are longer than those of the gastric glands, being 30 micra in length, but their width and the size of their nuclei are not changed. The muscularis is 2 to 3 mm. in thickness. Between the muscular bundles white septa are seen, which are made up of connective tissue without malignant cells.

This case shows an early stage of "cylinder-cancroids," and is of interest because it illustrates that this type of cancer, which, because of its structural similarity to the benign polypi, has been traced to chronic catarrh of the stomach, may develop on a previously normal mucosa.

I was unable to demonstrate satisfactorily the direct connection between these tumors and the gastric glands. These were widened once only in the edge of the growth. Meanwhile I shall accept Cornil and Waldeyer's theory of development as far as these tumors go, because this seems the most plausible, and also because, as I have said previously, the breaking through the muscularis could readily be overlooked or have sloughed away, while the tumor mass kept on growing in the submucosa.

MIXED FORMS OF "CYLINDER-CANCROID" AND CARCINOMA (*E. Wagner**)

Reinhardt† first observed that certain of the alveoli of cylinder-cancroids, or, as he called them, "widened gland fundi," were not lined by the ordinary columnar epithelium, but filled with a mixture of these and polymorphous cells or by polymorphous cells alone. He often found these irregular cells in the neighborhood of abscesses or at the edge of the tumors, and concluded from this that nutritive changes occurred which interfered with the usual development of the tumor-cells, so that they failed to reach the columnar shape, but stopped at a lower stage of development as irregular polymorphous cells. Wagner‡ was the first who really grasped the situation. He considered them border forms between cylinder-cancroids and carcinomata. He showed that every imaginable type of these could occur, and that they were frequent in the stomach, where he found two cases, in the large intestines, and in the cervix of the uterus. Later authors—Cornil and Waldeyer—who do not recognize any difference between cylinder-cancroids and carcinoma do not place any emphasis on these border tumors, but consider the form of the cells accidental and immaterial. Since these views are not generally adopted and I have separated the "cylinder-cancroids" from the carcinomata, it appears best at present to group these mixed forms by themselves, not in order to make them appear as a separate type, but simply to emphasize the fact that they are among the most frequent forms of cancer in the stomach.

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* "Weitere Beiträge zur Kenntniss des Krebses, mit regelmässiger Zellenlagerung," Archiv f. physiol. Heilkunde, 1859, vol. iii, p. 246.

† *Loc. cit.*, p. 9.

‡ *Loc. cit.*, p. 210.

These mixed forms occurred 9 times in my 30 cases. They were located 6 times in the pyloric end and thrice on the lesser curvature. They were all either soft or semisolid, ulcerated forms, which in their outward appearance and mode of extension were entirely similar to the medullary carcinomata. Structurally, these mixed tumors have their alveoli arranged in groups, hence to this extent are analogous to the adenomata. Their alveoli often vary greatly in size,—from 0.06 to 0.24 mm. in diameter,—and the carcinomatous bodies are at times (Case XXVII) so arranged as to appear deceivingly like a longitudinal section of one of the saccular glands of the large intestines. As far as the epithelium goes, the alveoli are at times lined with regular columnar cells, at others with round- or polymorphous cells, and at still others with transitional types. An alveolus of this type is seen in Fig. 3 of Plate I; to the left is one covered with columnar cells; at "*b*" is a group of transitional cells some of which are more like cylinders; others are more round or angular, yet they resemble the columnar cells somewhat; finally at "*c*" are found entirely indifferent cells.

These two kinds of cancer tissue may occur uniformly mixed in the tumor, as in the following case, from which the figure referred to above was taken:

Case XVIII.—*Mixed form of "cylinder-cancroid" and carcinoma. Alveoli contain transitional forms of the two types of epithelium. Semisolid ring-shaped ulcerated tumor in the pyloric end of the stomach. Stenosis of the pylorus with dilatation of the stomach. Benign hyperplasia of the glands in the lesser omentum. Diffuse bronchitis. Hypostatic pneumonia of the lower lobe of the left lung. Fatty liver.*

Jörgen Petersen, sixty-five, fireman. Autopsy April 16, 1872, twenty-four hours after death. There is no fluid in the peritoneal cavity. A nodular new-growth is present in the region of the pylorus, involving partly the stomach and partly the greater omentum. The pyloric end is retracted so that its lumen barely admits one finger. At this place occurs a ring-shaped ulcer 8 cm. long, which sends an extension 5 cm. long toward the cardia on the lesser curvature. The edges of the ulcer are firm, uneven, infiltrated, and everted. Their surface is covered with soft, injected shreds of tissue, underneath which a firmer tissue can be felt. The floor of the ulcer is irregular, and is made up of soft white parts of necrotic tissue with villi occurring between round, firm, discolored nodules. Cut sections of the edge show the wall of the pyloric end to be changed into a thick, grayish, semisolid mass, consisting of firm, transparent bundles surrounding a soft grayish mass from which an abundance of milky juice can be expressed. The mucosa of the fundus is pale and somewhat thinned. Only the lymph-nodes nearest to the ulcer in the lesser omentum are carcinomatous. The pancreas is unchanged. The spleen is pale and small.

The liver is markedly infiltrated with fat, but free from metastasis. The rest of the organs are somewhat anemic, but otherwise unchanged.

Microscopic examination shows the mucosa of the corpus ventriculi to be 0.5 mm. thick. The cells in the bottom of the glands are everywhere distinct. Their form is rather unusual. They are very tall and narrow, being 22 x 5 micra. The mucosa at the edge of the ulcer is 15 mm. in thickness, covered with naked, lengthened villi. The fundi of the glands are not perceptibly widened. The muscularis mucosæ contains masses of malignant cells, either scattered in groups or arranged in groups of alveoli, some of which are lined with cylindric cells. Others are covered with round- or polymorphous cells as large as 14 micra in diameter, containing round nuclei from 6 to 8 micra in diameter. The submucosa is changed into a white tumor mass, 6 mm. in thickness, consisting of a connective tissue rich in small round-cells, in which occur groups of alveoli lined with round or polymorphous cells, and alveoli lined with regularly arranged columnar cells. Besides these two forms, there are alveoli lined with both columnar and transitional forms of epithelium, and between these are found round-cells, and finally round- and polymorphous cells of the usual type. The two varieties of cancerous tissue occur everywhere in the tumor, but they are so arranged that each type is collected into definite areas with transitional types between. In the region of the tumor the muscularis is thickened (6 mm.) and narrow; white septa are seen between the bundles. These are made up entirely of connective tissue. The lymph-glands are the site of benign hyperplasia without signs of malignancy.

In other cases the two forms of malignant tissue are separated in different parts of the tumor, as was the case in the following instance, in which the central, older part is a "cylinder-cancroid" and the peripheral portion is medullary carcinoma in structure:

CASE XIX.—*Mixed tumor. "Cylinder-cancroid" and carcinoma. A very large ulcerated tumor on the left half of the lesser curvature on the anterior wall of the stomach. Soft medullary carcinoma at the edge of the tumor. Cylinder-cancroid mixed with carcinoma in the middle of a directly transplanted tumor in the liver.*

Karoline Eskom, sixty-nine, pauper. Autopsy June 18, 1872, twenty-four hours after death. The peritoneal cavity contains 1000 c.c. of a reddish, serous fluid. The stomach is small and adherent to the left lobe of the liver. It is 16 cm. long, 7½ cm. wide, and holds 450 c.c. It contains a grayish-green fluid. Along the lesser curvature is a markedly ulcerated tumor, which is 9 cm. broad and 10 cm. in height. Most of it is situated on the anterior surface of the corpus and the fundus of the stomach. It begins at the right edge of the cardia, the orifice of which is free except for a small portion of its right edge. The tumor extends to within 8 cm. from the pylorus; the mucosa between it and the pylorus is thick, thrown into folds, and pigmented, but free from malignant cells. An area, 9 cm. in diameter, forming the main part of the tumor surface, is ulcerated, the floor being irregular, with necrotic shreds of tissue, the edges uneven and infiltrated, formed by a soft tumor mass 3 cm. at its thickest. From the cut surface of the edge flows, in places, a large amount of a thick, purulent fluid, consisting of medium-sized, round granular cells, having large nuclei, fat-globules, and a granular débris, but there are no columnar cells. In the surrounding mucosa occur numerous pinhead to hempseed-sized yellowish-gray nodules. Near the lesser curvature, on the serous surface of the stomach, occur some white, hempseed-sized nodules. The rest of the peritoneum is free from metastasis.

The liver is small and pale, and free from metastatic growths. The retroperitoneal glands are not involved, nor are those in the posterior mediastinum. The remaining organs are anemic, but otherwise unchanged. Microscopically, the tumor at the edge of the ulcer consists of alveoli, either arranged in groups or uniformly distributed, and lined with round- and polymorphous cells, 15 micra in diameter, and containing round large nuclei, 12 micra in diameter. The older parts of the tumor consist of a granular, degenerated connective tissue in which are found large cavities lined with columnar epithelium. A few of the smaller alveoli are lined with polymorphous cells. The slightly thickened muscularis becomes lost in the tumor tissues 1 cm. inside of the edge of the ulcer. From the part of the stomach adherent to the left lobe of the liver a semispheric tumor the size of a walnut extends into the parenchyma of the organ. The rest of the liver is free. This cancerous mass is a mixture of cylinder-cancroid and carcinoma. The small tumors outside the stomach consist partly of connective tissue infiltrated with large round epithelial cells and partly of carcinomatous tissue.

In Case VII I was able to follow the development of the cancerous cells from their origin in the gastric glands of the mucosa very clearly. These were widened, twisted, and folded irregularly in 6 of 9 cases; the mucosa was macerated once, and twice it was free from visible pathologic changes. I must emphasize this relation of the glands to the carcinomatous cells, in spite of Wagner's* assertion that he could not find the gastric glands taking any active part in the formation of a cancer, but in all his cases could demonstrate that the malignant cells originated from connective-tissue cells. I have previously called attention to the difficulty of directly proving the relationship of the gastric glands to the malignant cells. But the individual, well-established cases showing this count for a great deal, and these, in addition to the irregular growths of the glands present in the large majority of my cases, clearly indicate that the theory of development held by Cornil and Waldeyer is the correct one for most of these cases.

Metastases in these mixed forms are nearly as frequent and as extensive as those of medullary carcinomata. Only 2 cases (Cases XVIII and XIX) were entirely free from secondary growths. In the remaining 7 cases metastasis in the lymph-glands were present 6 times, in the liver 6 times, in the peritoneum twice, in the veins of the stomach twice, in the vagi twice, and in the cerebellum once. The structure of the metastatic growths were, as one might expect, mixed, like the original tumor, in the large majority of cases. In some instances the metastatic nodules were pure carcinomata, and rarely pure cylinder-cancroids. The malignant lymph-nodes were of mixed structure four times and pure carcinomata twice. The cylinder-cancroids and the mixed tumors live and spread in the same organs, as do the carcinomata, yet the serous surfaces in these cases—the peritoneum—seem nearly always to produce carcinomata. This was the type of cancer in all my 4 cases of cancer of the peritoneum. However, Wagner† has observed a case of multiple cancroids on the peritoneum.

* *Loc. cit.*, p. 280.

† *Loc. cit.*, p. 263.

Alveolar Cancer; Gelatinous Cancer (*Otto**)

(Carcinoma Alveolare, Colloides, Gelatinosum)

This peculiar type of cancer is characterized by a gelatinous mass filling alveoli, surrounded by a stroma differing from that of carcinomata only by the scarcity of vessels. I have never observed it in fresh condition. For this reason I shall not consider their structure in detail, but refer to pathologic hand-books (Rokitansky, Förster, Rindfleisch, etc.). The majority of writers hold that this is a rare form of cancer of the stomach. Habersohn† states that it is rare. Brinton‡ found it 43 times in 417 cases. Lebert § found 6 in 57 cases, and Eppinger|| reports 5 in 116 cases. Hannover ** takes the very opposite view, and considers alveolar cancer as being the most frequent of all carcinomata in the stomach. Judging from my own experience, alveolar cancer must be a rare form, since, as has been mentioned, I have not met a single case at autopsy. In the museum (Professor Reitz has been kind enough to throw the entire museum open to me) I have found two cases of this type of carcinoma, and my investigations are limited to those.

Alveolar carcinomata are rarely found as circumscribed (encapsulated) tumors, as is the case with the carcinomata. They generally form a diffuse degeneration of the pyloric half of the lesser curvature. At this point rather large growths may occur, as in one of Eppinger's cases, in which the lesser curvature was changed into a tumor as large as a child's head. At times the entire organ may become uniformly infiltrated. The wall of the stomach in such cases may reach an enormous thickness —it was 1.5 cm. in one of Eppinger's cases. As a rule, the stomach cavity is markedly reduced, but it may be normal and even enlarged. According to Rokitansky,†† colloid cancer begins as a degeneration of the submucous connective tissue and extends, from this point through the muscularis into the peritoneum and up into the mucosa. This layer is changed into a large-meshed network, in the meshes of which is found a gelatinous mass which can be seen by the naked eye on the inner surface of the stomach. When pressure is applied to the surface of the organ, this mass flows out as large drops or lumps. Cruveilhier ‡‡ describes these tumors under the title "Degeneration alveolaire et gelatiniforme de l'estomac." In a few cases he has seen the tumor extending up into the esophagus and into the first part of the duodenum. He believes that the degeneration begins in the mucosa, since this layer is always most pronouncedly changed and always involved most extensively. The submucosa is affected at a later stage. According to Cruveilhier, ulceration develops slowly, and it is more like the wear of an inorganic body than that of an ulcerating malignant growth. At times the mucosa looks

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[*] Seltene Beobachtungen zur Anat., Physiolog., und Pathol., 1816, p. 19

[†] *Loc. cit.*, p. 122.

[‡] *Loc. cit.*, p. 240.

[§] *Loc. cit.*, p. 477.

[||] *Loc. cit.*, p. 6.

[**] *Loc. cit.*, p. 61.

[††] *Loc. cit.*, p. 175

[‡‡] Traité d'anatomie pathologique generale, 1864, vol. v, p. 16.

as if pecked at by birds. However, the ulcer may penetrate the different layers of the stomach-wall in the diffuse types of these growths.

As an example of circumscribed tumor of this type on the lesser curvature I cite the following case:

CASE XX.—*Museum specimen No. E 41. Alveolar cancer. Large ulcerated tumor on the lesser curvature. Circumscribed form.*

The stomach is somewhat reduced; the lesser curvature is 13 cm. long, and the greater, 26 cm. The fundus is markedly retracted, so that it is even more narrow than the pyloric end. Along the lesser curvature, on the serous side, occurs a flat, nodular tumor mass on the surface of which are seen vesicles varying in size from that of a pea to a nut, and filled with a clear, transparent, gelatinous mass. On the mucous surface of the lesser curvature occurs an enormous ulcer, 12 cm. long, and extending 7 cm. over the anterior and posterior surfaces. The edge of the ulcer consists of a belt of malignant tissue, 3 cm. wide and 1 cm. in thickness, of soft consistence. It consists of a delicate framework containing from pinhead- to pea-sized cavities opening on the surface, and filled with a clear, gelatinous mass which on pressure flows out. The mucosa cannot be distinguished from the tumor mass. The ulcer has penetrated the muscularis, and the part of this layer nearest the ulcer is slightly thickened, and small clear spots occur between the muscular bundles. The floor of the ulcer is partly white and firm, formed by the thick submucosa, and partly covered with gelatinous material. Outside of this ulcer the wall of the organ is neither infiltrated nor thickened.

Microscopic examination shows the tumor mass at the edge of the ulcer to be made up of slender bundles of connective tissue, between which occur large cavities penetrated by a very delicate network of fibers, which spring from the heavier bundles that form the walls of the cavities. The spaces between these fibers are filled with a gelatinous mass which is finely granular and contains scattered granular cells, 9 to 15 micra in diameter, having round nuclei 6 micra across, and pieces of granular cells. There are no large cells in colloid metamorphosis. The smooth portion of the floor of the ulcer consists of a firm fibrillar connective tissue which is non-malignant.

The development of colloid cancer has not been definitely cleared up as yet, and is still the subject for various speculative views. Rokitansky* held that the gelatinous substance originated from blastodermic cells. E. Wagner† believes it due to colloid degeneration of cancer-cells, especially the columnar type. Klebs‡ considers alveolar cancer as one of the types of connective-tissue cancer, and he believes that the gelatinous masses are formed by colloid degeneration of the connective-tissue elements. The greater number of investigators at the present time agree with Wagner that the gelatinous masses are formed from colloid degeneration of the cancer-cells, hence this type has the same origin and mode of development as have the carcinomata. This is Waldeyer's§ idea. Stradowsky|| observed that the colloid cancer developed from the gastric glands. These became dilated, twisted, lost their basement membrane, and sent outgrowths of which the cells underwent col-

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* Virchow's Archiv, 1855, vol. i, p. 281.

† Archiv f. physiolog. Heilkunde, 1860, vol. ii.

‡ Handbuch der pathol. Anat., 1. Lieferung, p. 196.

§ Virchow's Archiv, 1868, vol. xli, p. 470.

|| Zur Lehre über die Entwickelung des Colloidkrebses im Magen und grossen Netze, St. Petersburg, 1868.

loid degeneration and formed the gelatinous masses. Similar conclusions were reached by Rudnew.* In one of my specimens the tumor was so well preserved that I was able to trace the development of the cells. I noted widened glands filled with colloid material and cells directly connected with the alveoli of the submucosa. Hence as far as this case goes I agree with Stradowsky and Waldeyer that this form of cancer develops from the glands of the mucosa. This case also illustrates the diffuse form of alveolar cancer, and for this reason I give it below:

CASE XXI.—*Museum specimen No. E 55 b. Alveolar cancer. Diffuse infiltration of the entire stomach, with marked contraction, but without ulceration.*

The entire stomach is markedly reduced. The lesser curvature is 12 cm., and the greater is 28 cm., long. The shape is greatly changed; the fundus is absent, and the stomach has the shape of a sausage or a piece of the intestines; in the neighborhood of the cardia the stomach is 5 cm. in diameter and at the pylorus 6 cm. Hence the fundus and the body are contracted to such a degree that this part of the organ is narrower than the pyloric end. The serous surface of the stomach is smooth, but finely granular, due to numerous from pinpoint- to pinhead-sized clear vesicles which are slightly raised from the surface. The cavity of the organ is so reduced that it only holds a finger. The mucous surface is irregular, and studded with flat, round, from pea- to walnut-sized nodules. The surfaces of these are areolar, and are seen to consist of a fine network of white fibers surrounding cavities as large as a hempseed, which are filled with a clear, transparent, gelatinous mass, which flows away as drops or clumps on pressure.

The gastric tissue is diffusely thickened from the cardia to the pylorus. It varies between 12 and 15 mm. in thickness. This increase is distributed among the various layers of the wall as follows: The muscularis is 4 mm. in thickness, penetrated by white septa and fibers in which are small, clear, punctate vesicles. The muscular layer is whitish, 6 to 8 mm. in thickness, containing numerous clear blebs, and in direct contact with the flat tumors described above. Between the nodules is found a gelatinous mucous membrane separated from the white tumor substance underneath by a narrow white wall of the muscularis mucosæ. In this occur numerous white strips running parallel to each other and perpendicularly to the surface. These separate the gastric glands and their points of exit, and surround the gelatinous masses. There are a few enlarged lymph-nodes at the cardia.

Microscopically, the mucosa is thick, and bears a few scattered villi on its surface. It consists of a network having long meshes, made by thin bundles of connective tissue arranged perpendicularly to the surface. In these walls of separation occur numerous small round-cells, but there are no vessels. The gastric glands are often markedly dilated, especially toward the muscularis mucosæ. Few of the glands are lined completely by the usual type of epithelium, but most of them are filled with colloid material in which occur a few granular cells, pieces of cells, and fat-droplets, with a few cholesterin crystals. These gelatinous masses increase toward the muscularis mucosæ, where the glands become few and widely separated. In the parts where the degeneration has developed farther, the glands are greatly widened and entirely filled with the gelatinous substance to the surface of the mucosa. The tissue below this consists of a thicker connective-tissue stroma containing large alveoli. These are penetrated by a finer network of connective-tissue fibers, and the smaller partitions thus formed are filled with a clear colloid material where either groups or individual granular round-cells are found. Few of the cells have a distinct round nucleus. Between the two layers just described are seen less degenerated layers of the muscularis mucosæ, which forms a thin dividing wall between them. Here and there in this layer occur individual gland fundi filled with a gelatinous substance, and extending through the muscularis mucosæ and directly into one of the large alveoli below. In parts of the stomach where the process has advanced still further the muscularis mucosæ is entirely lacking, and the large alveoli in the submucosa extend all the way to the surface, where they open, their walls becoming worn away, as it were, so that the gelatinous material lies unprotected on the inside of the stomach. Between the bundles of muscles in the muscular layer occur large masses of a similar alveolar-gelatinous tissue. In cross-section these have irregular dentate outlines, due to the alveoli having forced their way, so to speak, between the muscular bundles. But these reach only a little ways into the interstitial tissue, where they are replaced by connective tissue. In the lymph-nodes are found a similar gelatinous cancer tissue containing smaller alveoli.

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* Virchow-Hirsch Jahresbericht, 1871, vol. i, p. 309.

I am unable, from my own cases, to make any statement as to the metastasis of this type of cancer. Metastatic growths are said to be rarer in this than in other forms of carcinoma (Förster). It is nearly always limited to the neighboring lymph-nodes and the peritoneum. Brinton,* on the other hand, holds that alveolar cancer produces metastatic growths more often than any other form. Thus 6 of his 7 cases of colloid carcinoma were accompanied with secondary growths, whereas only 4 out of 7 of the medullary forms and 3 out of 7 in scirrhous carcinoma showed metastasis. Often the secondary growths are medullary carcinomata, and the primary growth may be a mixed form of alveolar and cylinder-cancroid or medullary carcinoma (E. Wagner).

METASTASIS

I have already called attention to the metastasis of the individual forms of carcinoma in order to make clear their relative frequency to other forms. At this point I wish to follow the usual custom of the writers and give the frequency of secondary growths in the various organs. Metastatic growths were present in 27 of my 29 cases of primary carcinoma of the stomach. One of the 2 cases free from secondary growths was an instance of beginning cylinder-cancroid, the patient dying from pneumonia. The other was an older cylinder-cancroid, where the patient died in the fourth month of the disease from peritonitis.

As in cancer anywhere in the body, the lymph-glands are most frequently secondarily involved. They were infiltrated with malignant cells in 24 cases, or 88 per cent. The nodes along the lesser curvature in the gastrohepatic ligament were most frequently affected, namely, 16 times. Then follow the retroperitoneal glands, 6 times, the glands of the greater curvature and in the greater omentum, which were involved 6 times. The malignant cells reached the glands along the esophagus and aorta twice; only once were the supraclavicular glands on the left side carcinomatous. Brinton† rightly calls attention to the fact that it is difficult to distinguish between degenerated lymph-glands along the curvatures and independent metastatic growth from the stomach. For this reason he as well as I have grouped these two conditions into one and called both degenerated lymph-nodes. He found metastatic growths along the curvatures in 25 per cent. of 271 cases; I found it in 16 of 27 cases, making the frequency 59 per cent., hence twice as frequently as he. The other writers do not give this relation accurately.

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* *Loc. cit.*, p. 244.

† *Loc. cit.*, p. 245.

The structure of the malignant tissue in the lymph-nodes is not always that of the primary tumor, since in two cases of "cylinder-cancroids" the cancer tissues of the lymph-glands in one had the structure of a "cylinder-cancroid," and the other that of a carcinoma, and 3 of 6 cases of mixed cancer were mixed in the lymph-glands too, but the other 3 were pure medullary carcinomata.

The liver comes next to the lymph-glands in the order of frequency of secondary growths. This organ was involved 13 times in my 29 cases, making the frequency 45 per cent. The primary location of the cancer did not appear to influence the involvement of the liver; it was affected 9 times in 19 cases of carcinoma of the pylorus, and 4 of 8 times in tumors of the lesser curvature. The form of the malignant growth seems to have this much to do with metastatic growth in liver, that the organ was free in 5 cases of scirrhous carcinoma and involved in half of the cases of the other varieties, viz., in 5 of 10 cases of medullary carcinomata, in 3 of 6 of cylinder-cancroids, and in 5 of 8 of mixed forms.

The consistence of the tumor is not without effect on the involvement of the liver, and the usual experience that the softer forms are the most malignant was also shown here, since 11 soft tumors had liver metastasis in 7 cases, whereas it occurred only 6 times in 13 semisolid tumors.

Other writers found the liver involved less frequently than I. Thus Lebert gives 15 of 57 cases, or 28 per cent.; Dittrich has 41 of 151, or 27 per cent.; and Brinton, 105 of 431 cases, or 25 per cent. Metastatic tumors occur in the liver in the form of multiple tumors varying in size from scarcely visible nodules to tumors the size of an adult fist and larger. As a rule, secondary carcinoma of the liver does not reach the size of the tumors formed when the organ is primarily involved. Yet such cases were found in 3 of my cases. Two of these were medullary carcinomata in which the organ weighed 5715 and 3875 grams respectively, and the third was a cylinder-cancroid in which the liver weighed 3785 grams. The weight of the normal organs varies, according to Frerichs,* between 820 and 2100 grams. Hence the organ was twice its normal size in the cases cited. The relation of the structure of the liver tumor to that of the primary growth I found to be this: Three cases of primary cylinder-cancroid had cylinder-cancroid in the liver twice, the third being a medullary carcinoma, and in 5 cases of mixed primary form the metastasis was mixed twice—twice cylinder-cancroid and once carcinomatous. At times the secondary tumors in the liver undergo rapid granular and fatty degeneration, while the primary tumor remains unchanged, and without there being any recognizable cause for it in the liver. The following case is an example of this:

CASE XXII.—*Large-celled carcinoma. A rather soft ulcerated tumor on a scirrhous base on the posterior wall of the pyloric end. Stenosis of the pylorus with dilatation of the*

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* Klinik der Leberkrankheiten, p. 18.

stomach. Caseous degeneration of the carcinomatous lymph-nodes along the esophagus, and of the malignant tissue in the liver. Abscess of the posterior mediastinum, with perforation into the esophagus and into the left bronchus. Calcification of a part of the right lung.

Anders Hansen, age fifty-five, laborer. Autopsy twenty-four hours after death. The body is extremely emaciated, 176 cm. long. Rigor mortis is absent. Over the sacrum is a decubital ulcer, 3 cm. in diameter. The pericardium contains a small amount of a clear serous fluid. The heart is small; there is no fat in the fissures, and the coronary vessels have an irregular course. The myocardium contains a few gray spots. It is non-transparent, soft, and slightly granular. The liver is of normal size and shape. In its parenchyma occur numerous from pea- to nut-sized nodules, the cut surface of which is yellowish gray, like that of a caseous lymph-gland.

Microscopically, the tumors in the liver consist of a finely granular necrotic tissue; hence the cheesy appearance. In this the outlines of large alveoli with degenerated cells can barely be made out. Between the liver parenchyma and the malignant tumors occurs a layer of young connective tissue rich in small round-cells, which also extends a short distance in between the liver-cells. The carcinomatous lymph-glands have a structure similar to that of the nodules in the liver.

Lebert* has observed a similar case in which the tumor mass had degenerated to such an extent as to be unrecognizable. He does not express any opinion as to the cause of this rapid destruction.

Metastasis in the peritoneum was found 11 times, or in 40 per cent. of my cases. Dittrich found 22 of 151, or 14 per cent.; Lebert reports 11 of 57, or 19 per cent. In these cases the greater omentum is often greatly retracted as a sausage-shaped mass transversely, close to the greater curvature of the stomach. Such a condition was present in 7 of my cases. Most frequently the serous surface of the entire abdominal cavity is strewn with small nodules. Once a single large tumor occurred in the greater omentum. In another case a group of smaller tumors in the greater omentum was the only metastasis present. Once the peritoneum of the lesser pelvis was the only part involved, and in another case the number of nodules in this part of the cavity was far greater than at any other place.

These instances indicate that the cancer-cells attack the serous linings from their peritoneal surface by the malignant tissue being seeded, as it were, over that surface. They then sink down into the true pelvis, and accumulate there, thus leading to the most pronounced secondary growths at this place. The small nodules on the peritoneum consist, as a rule, of the typical carcinomatous tissue—in 9 of 11 cases; twice the bulk of the nodules was made up of connective tissue in which occurred, however, large scattered epithelial cells. Twice the pleura contained secondary nodules, similar to those on the peritoneum. In one of these the carcinoma had extended from the abdominal cavity through the diaphragm.

I did not observe metastatic growths in the lungs. This is rather peculiar, since other observers have noted this condition quite often. Thus Dittrich found 9 in 151 cases, or 6 per cent.; Lebert saw 7 in 57, or 12 per cent.; and Brinton reports 35 of 431 cases, or 8 per cent. Brinton* states that the lungs are rarely if ever involved when the liver is the site of secondary growths, but the organs drained by the portal vein are more apt to be involved with the liver. He, therefore, believes that liver metastasis in a way protects the lungs. He bases his ideas on the fact that he found 47 cases of secondary growths of the liver in which the lungs were free from metastasis in all but one. Dittrich† agrees with him as far as the lungs are concerned. He found only 1 case of lung involvement in 43 with secondary growths in the liver. But Dittrich has not observed the frequent involvement of the abdominal organs in such cases. On the contrary, he holds that only the lymph-glands nearest to the stomach are involved with the liver.

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* *Loc. cit.*, p. 587.

Metastatic growths are, on the whole, rare in the bony skeleton. Lebert found metastases in the bones in 2 of 57 cases. Once secondary growths occurred in a number of the bones; at the same time the skin was the site of multiple carcinomatous nodules. In the other case the malignant cells involved the base of the skull and also a number of the bones of the extremities where spontaneous fractures took place. In this type of cases the cancer is generalized, and the poison is swimming free in the general circulation. In another type of cases the cancer simply extends into the bone from a cancerous organ in contact with it. Thus the malignant tissue may extend into the spinal column from the retroperitoneal glands (Brinton, Dittrich), and it may extend into the sternum from the glands of the anterior mediastinum (Brinton). The following case is an example of this:

CASE XXIII.—"*Cylinder-cancroid*": *a firm, non-ulcerated tumor of the half of the lesser curvature facing the cardia; multiple nodules in the liver and the pleura; cylinder-cancroid in the anterior mediastinum and in the sternum.*

P. Larsen, age sixty, laborer. Autopsy by Professor Reisz, October 24, 1872, twenty-two hours after death. There was nothing abnormal on the anterior surface of the sternum, but when the bone was being removed, abnormal mobility was felt at the fourth rib, and on the posterior surface of the sternum occurred a flat, round, semisolid tumor, about 3 cm. in diameter, which extended into the soft bone and was adherent to the pericardium. The pericardial surfaces in places were bound together by old adhesions. The myocardium was dark grayish in color and rather soft. On the visceral pleura were numerous white, slightly prominent nodules, about as large as peas. These extended only slightly into the lung parenchyma, which otherwise was free from carcinomatous tissue. There was no free fluid in the abdominal cavity.

The stomach contained 500 grams of a yellow, rather thick fluid. On the lesser curvature, close to the cardia, occurred a tumor as large as a child's head, which bulged into the organ. In its center was a sunken area surrounded by a prominent wall. The tumor was hard, cut with difficulty, its cut surface uniformly grayish white, and on pressure only a small amount of a milky juice exuded. The serous portion of the stomach over the tumor was adherent to the liver. There were old adhesions between the diaphragm and the liver. On its surfaces were numerous yellowish, white, soft nodules, with a smooth cut surface and a large amount of cancer juice. The retroperitoneal glands were somewhat enlarged. Microscopic examination showed that the sternal tumor, as well as the one in the stomach, were cylinder-cancroid (Reisz).

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* *Loc. cit.*, p. 245.

† *Loc. cit.*, p. 25.

Metastasis in the other organs of the body is rare. In my cases I found secondary growths once each in the kidneys, the gall-bladder, and the psoas muscle. In these cases the growth had extended directly into the organs from the involved connective tissue or lymph-glands near them. In 431 cases Brinton found secondary growth 7 times in the ovaries; 3 times in the uterus and pancreas; twice in the kidneys and the bladder; and once in each of the following organs: the adrenals, the seminal vesicles, the diaphragm, and the pericardium.

Cancer of the intestine may at times be coexisting with that of the stomach. The intestinal tumor is then, as a rule, located in the rectum; thus in 3 of Brinton's 431 cases, 2 of Dittrich's 151 cases, and 3 of my 29 cases cancer occurred in this part of the alimentary tract. Carcinoma of other parts of the intestine is much rarer than that of the rectum. Brinton found 2 cases in the large intestine and 2 in the small. I found the cecum involved in 2 of my cases of rectal carcinoma. In 1 of these the greater part of the colon was also involved in the same mass. It is doubtful if Brinton* is justified in assuming that the intestinal cancers are always secondary tumors. My 2 cases had diffuse scirrhous carcinoma of the stomach, and the malignant tumors of the intestines were of about the same age as those of the stomach, thus giving me the impression that they were primary in both places. It is not without reason to suppose that the cause which led to malignancy in one place might also act in other parts of the digestive canal.

In order to make plain the various routes by which the carcinomatous cells reach different organs of the body, I wish to discuss first the extension by means of veins, then by lymph-glands, and finally I shall have something to say in conclusion about carcinomatous extension to nerves which, as far as cancer of the stomach is concerned, has been very little considered hitherto.

Extension of Carcinoma Into the Veins

Cancer of the stomach may reach the veins by two slightly different routes: the primary growth may extend directly into the branches of the coronary veins, or the malignant cells may break into the stem of the superior coronary vein from the secondary nodules in the lymph-glands or in the lesser omentum. When the superior coronary vein becomes involved, the cancer tissue extends on into the portal vein.

In the cases where the malignant cells break into the smaller veins directly from the primary tumor the cancer-cells travel up along the smaller branches into the stem, and from the stem into other side branches again. Thus an extensive, markedly injected network of veins is found. Professor Reisz, in the autopsy record of Case XXV, has happily described this as a caput medusæ radiating down on the anterior and posterior surfaces. These dilated, wavy veins may be traced on the serous surface of the stomach as far as 3 or 4 cm. away from the curvature to the place where they penetrate the muscularis to form the plexus of the submucosa. From this point on they appear as branched strings underneath the movable mucosa, into which they do not penetrate, strange as it may seem. This must be due to the fact that the veins are obliterated at this point. In these cases the primary, usually ulcerated, tumors often contain veins from which plugs of cancer-cells can be expressed.

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* *Loc. cit.*, p. 250.

When, on the other hand, the carcinomatous cells penetrate the walls of the coronary vein from secondary growths in the lymph-glands or the lesser omentum, then the branches of the coronary veins, as well as the veins of the tumor itself, are usually free from malignant thrombi. But the part of the vein nearest to the portal, as well as the portal vein itself, is plugged with tumor-cells, and the peripheral parts of the coronary veins are destroyed by the tumor mass which has broken into and passed through them.

From the often dilated coronary vein the tumor-cells invade the portal. The growth first appears as a club-shaped nodule, free in the blood-stream, coming from the stomach and carrying masses of young cancer-cells and pieces of the tumor up into the liver. The external part of the tumor is soft, and has a scant stroma, with thin-walled, wide vessels, and the spaces between these contain masses of loosely adherent young cancer-cells. These are easily recognized from their large nuclei, often surrounded by a narrow zone of protoplasm. The portal blood contains in places groups of young cancer-cells or individual cells, and in other places clumps of the original tumor. These masses accumulate in the smaller branches of the portal vein, where, with the coagulated blood, they form malignant thrombi, which at times appear as round, slightly protruding plugs, visible to the naked eye, and which can be expressed from the branches.

Less frequently larger masses of the original tumor become adherent to the walls of the larger branches, for example, at the bifurcation of the stem, and without any direct connection with the cancerous thrombus. This may extend gradually up the vein, the club-shaped mass growing bigger, filling the lumen of the portal vein, which is often markedly dilated. The tumor most frequently extends along through the stem and into the branches to the parenchyma of the liver, but it may also travel down to the roots of the portal vein, especially to the splenic vein, and may even extend into one of the pancreatic veins.

The liver is always extensively involved in these cases, and the characteristic fact about the secondary growth in this organ is that small, pea-sized tumors appear in groups. The individual tumors are rarely spheric in shape, but irregular and stellate in outline. In a few cases they are seen to be a part of an injected vascular reticulum formed by the smaller branches of the portal vein. From these the carcinomatous tissue extends into the liver parenchyma. The small groups of tumors rapidly fuse into larger ones, and there is nothing characteristic about appearance and structure of these larger masses.

Cases of this type, in which the cancer-cells break into the veins, are of unusual interest both by the light they throw on carcinoma of the portal vein to have any direct connection with the malignant ulcer of the pylorus.

Bamberger* refers briefly to two cases of cancer of the portal vein. In one of these the entire vein to its finest branches was filled with a coagulum consisting mostly of nucleated cells of different shapes. There was no sign of malignancy anywhere else in the body. He, therefore, holds that the malignant growth originated spontaneously in the portal vein. His second case had ulcerated carcinoma of the pylorus, metastatic tumors in the liver, and cancerous thrombosis of the portal vein. In this case he thinks the malignant growths sprang from an eroded vein in the stomach.

Frerichs † briefly mentions having seen 5 cases of cancer of the portal vein connected with cancer of the liver. He does not mention the condition of the stomach in his cases.

Henoch ‡ also cites a case of cancer of the portal vein; but his case is of a doubtful nature. He found a thrombus in the splenic vein extending through the stem of the portal and into its left branch in a patient who had suffered from ascites.

The only case of cancer of the portal vein secondary to carcinoma of the stomach which has been thoroughly studied and accurately described is one reported by Spaeth,§ who, in a thirty-one-year-old woman giving symptoms of cancer of the stomach and liver with ascites, found a large ulcerated medullary carcinoma of the pyloric end. The veins of the stomach, both those along the lesser and greater curvature, were dilated and filled with cancerous masses. Thickened injected branches extended 1 cm. to 3 cm. over the wall of the stomach. The portal vein was dilated and filled with masses of carcinomatous tissue. These were of the medullary type, and had a definite stroma, with distinct vessels. All the portal tributaries, the splenic vein, and the veins of the mesentery and mesocolon were also involved. The cancerous masses in the latter extended to within 1 to 2 cm. from the intestine. In the surface of the liver were seen multiple tumors arranged in groups, and the small branches of the portal vein were injected in the neighborhood of the carcinomatous nodules, so that they appeared as "feine gewunden verlaufende, vielfach sternförmig sich verzweigende Striefen von gelblich-weisser Farbe." The branches of the portal vein were dilated and filled with masses of malignant cells. These could be traced toward the nodules on the surface, which were filled with a whitish-red, soft mass, and could be identified as the sinus-like ends of the portal vein. Spaeth believed the cancer-cells had broken into the gastro-epiploic vein; in the region of the pylorus this vein had been surrounded by the tumor mass and its walls destroyed, so that the place where the cancer-cells first broke through was difficult to find. Up to the present time Spaeth's case is the only reported instance of cancer of the portal vein in which the malignant thrombosis had a distinct stroma with vessels of its own, and it is also the only case in which the type of carcinoma definitely has been shown to be medullary.

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* "Krankheiten des chylopoetischen Systems," Virchow's Handbuch der speciellen Pathol. u. Therapie, Erlangen, 1855, p. 589.

† Klinik der Leberkrankheiten, 1861, vol. ii, p. 278.

‡ Klinik der Unterleibskrankheiten, 1863, vol. iii, p. 144.

§ "Carcinom im Inneren der Venen des Pfortadergebietes," Virchow's Archiv, 1866, vol. xxxv, p. 432.

After this review of the cases reported in the literature I wish to report the cases personally observed, and to each of them add such explanatory remarks as the case may need:

(*a*) CASES WITH TUMOR MASSES IN THE SMALLER VEINS OF THE STOMACH, WHICH ORIGINATED IN A PRIMARY TUMOR OF THE STOMACH

CASE XXIV.—*Medullary carcinoma with medium-sized cells. A small, flat ulcer with soft, slightly infiltrated edges on the lesser curvature near the pylorus. Cancerous thrombosis of the veins surrounding the tumor and also of the rest of the veins from the pyloric end as far as to the superior coronary vein, half of which is involved. Carcinoma cells in the blood of the coronary veins. Multiple tumors of the liver. Infiltration of the lymph-glands of the lesser curvature. Lobar pneumonia of the upper lobe of the right lung.*

Fredrikke Andersen, age fifty-six, had pains in the right hypochondrium for four months, and felt a tumor first in the region of the right lobe of the liver, and later also in the region of the left. Progressive emaciation. Absolutely free from stomach symptoms up to the last day she lived. Then she vomited several times, and gave signs of lobar pneumonia in the upper lobe of the right lung. During her illness diarrhea was occasionally present. She had been in bed nineteen days. The disease lasted five months.

Autopsy, twenty-four hours after death. The body is emaciated. Rigor mortis present. The upper lobe of the right lung is in the state of gray hepatization of lobar pneumonia. The lower lobe is edematous. The peritoneal cavity contains a small amount of reddish, serous fluid. The peritoneum is smooth and unchanged. The liver is markedly enlarged, with a round, nodular tumor in the right lobe, and reaches about 13 cm. below the costal arch. The stomach is of normal size and shape, and contains a small amount of a grayish fluid. The mucosa of the entire fundus is softened. On the lesser curvature, 2 cm. from the pylorus, occurs a round, flat ulcer, 3 cm. in diameter. The floor of the ulcer is smooth, reddish gray, finely granulated, and there appear numerous whitish-yellow points, varying in size from a pinpoint to a pinhead. Small drops of a purulent fluid can be expressed from these, and this fluid is seen to consist of a granular detritus containing round- or polymorphous cells with large round nuclei. The bottom of the ulcer is formed by the not perceptibly thickened submucosa, in which occur small, whitish-yellow, soft spots. The submucosa is adherent to the muscularis, which is not thickened (1 mm.). The edge of the ulcer is flat, smooth, and even, but the mucosa covering it is slightly thickened (1 to 1½ mm.), freely movable on the muscular layer, since the submucosa is not perceptibly infiltrated, but in it are found a few small, yellowish-white, twisted strings, which are from ¼ to ½ mm. in diameter. These are the injected veins. On the inside of the posterior wall of the stomach, about 3 cm. from the ulcer, are outstanding, raised, branched strings, which in cut section are seen to be veins filled with soft, purulent masses. On the posterior surface of the organ, close to the lesser curvature, and corresponding to the place of the ulcer on the inside, is a mass of dendritically branched strings, which extend from the slightly dilated superior coronary vein, 2 to 3 cm. down on the posterior surface of the stomach, where they disappear, to become visible again on the inside of the organ as the branched strings described above. When the coronary vein is slit open, the portal half of it is seen to be filled with liquid blood, and its walls are unchanged Besides the ordinary corpuscles found in blood, this contains medium-sized round polymorphous cells, having a scant, finely granular cytoplasm and large round nuclei. These cells are found singly or in small groups.

In the superior coronary vein, just peripherally to the junction of two larger branches to the main stem, and about in the middle of the lesser curvature, there is found the rounded end of a soft white mass which entirely fills the rest of the vein and extends into the branches. This white substance is a soft tumor mass which is adherent to the walls of the vein and contains blood-vessels visible to the naked eye. Microscopically, the mass consists of medium-sized polymorphous cells having a finely granular but scant protoplasm, and large round or oval nuclei. These cells are held by a stroma consisting almost exclusively of varicose vessels and exceedingly thin walls. The injected peripheral veins contain a reddish-gray, purulent fluid, with granular débris, indifferent cells, and a few larger polymorphous cells with distinct nuclei. The portal vein is free from thrombi, and contains normal liquid blood which, on microscopic investigation, contains only the normal elements.

The liver is markedly enlarged—it weighs 3875 grams. Across the lower portion of the right and left lobes of the liver run constricting bands. The part of the right lobe below this band protrudes as a tumor the size of a child's head below the costal arch. The corresponding part of the left lobe forms a tumor as large as a fist. Both these parts and the rest of the organ are riddled with cancerous tumors, varying in size up to walnut size, and besides these there occur four tumors larger than a fist. Where these malignant tumors reach the surface they have retracted centers. They are soft but non-fluctuating, and their cut surface is whitish gray, and exudes an abundance of a purulent juice consisting of detritus and medium-sized round and polymorphous cells. The surrounding liver parenchyma is opaque and soft. The vagi are normal. Two of the glands at the lesser curvature are large as nuts, and contain a soft, yellowish, caseous mass. The rest of the organs were normal.

Microscopic examination shows that the mucosa of the corpus of the stomach is not thickened. The cells of the gastric glands are very granular in the fundi, but they are not separated from each other. The epithelium is missing at the mouths of the glands. The mucosa is slightly thickened at the edge of the ulcer. The fundi of the gastric glands are not markedly dilated, but from the deep layer of the mucosa masses of cells extend through the muscularis mucosæ, and underneath this is a thin layer of connective tissue rich in cells, containing large groups of alveoli filled with medium-sized cells, which are round or polymorphous in form and 12 to 15 micra in diameter, with round nuclei 6 micra in diameter. It is impossible to decide if any of the alveoli are dilated veins. There are no malignant cells between the bundles of muscle-fibers in the muscularis. On the other hand, the veins of this layer, which are 0.8 mm. in diameter, are filled with cancer tissue, the stroma of which is formed from the inside of the lumen. The walls of the veins, as well as the connective tissue outside, are free from cancerous growths, and the adventitia is free from round-cell infiltration. The walls of still smaller veins are infiltrated in places with granular cells, 9 micra in diameter, which reach the intima. The adventitia of these vessels contains in parts groups of small round-cells, and in other places oval spaces filled with larger granular cells. Whether these are alveoli cut across or simply lymph-spaces filled with cancer-cells cannot be determined. The stroma of the cancer mass in the superior coronary vein springs from the vessel-wall. Here and there the intima of this vein is invaded by the malignant cells, but the media is everywhere free from cancer-cells. The stroma here is of the same structure as that in the stomach. The tumors of the liver have a delicate stroma, forming alveoli filled with cells, similar to those of the tumor in the stomach. Surrounding these tumors, as a rule, is a capsule formed by connective tissue. In some places the alveoli run right against the somewhat degenerated liver-cells, which do not take any active part in the development of the tumor. The lymph-glands contain a markedly degenerated carcinomatous tissue of a structure similar to that of the liver tumors.

This case is of interest partly because it, as it were, forms the introduction to cancer of the portal vein, since the malignant tissue had reached only to the middle of the superior coronary vein, and partly because there is no doubt of this having started from cancer of the stomach, because only the veins of the part of the stomach nearest to the malignant ulcer were involved. I shall briefly give the various ways in which cancer of the portal vein is believed to originate:

I. Primary Cancer of the Veins.—Cruveilhier thought all cancer developed from or was formed in the venous capillaries. This idea was not based upon actual observation. Others, as Velpeau[*] and later Virchow,[†] thought that a thrombus might be changed into a cancer. Carswel, and later Rollet,[‡] believed that the cancerous cells were formed in the blood. Sick[§] holds that cancer primary in the veins has never been seen and does not exist.

II. Secondary cancer of the veins has been thought to originate:

(*a*) By a thrombus being changed into malignant tissue by the cancer cells springing from the white cells and from the young connective-tissue cells present in an organizing thrombus (Virchow and Sick).

(*b*) As a result of phlebitis, the product of the inflammation being changed into cancerous tissue instead of pus, due to a cancer being present in the neighborhood (Meyer).

(*c*) As a metastatic growth in the adventitia, when it was not in contact with the primary malignant tumor (Broca).

(*d*) As a result of cancerous degeneration of the wall of the vein as far as the malignant tumor extended. This was supposed to be produced by the cancerous tissue occluding the lumen. Against this is the fact that the walls of the larger veins are never involved to the extent of the cancerous thrombus. Sick thought he observed cancer-cells develop from nuclei in the walls of the venules in a case where a cancer of the parotid had extended into the veins.

(*e*) By emboli from a cancerous thrombus. This can be seen in the branches of the portal veins of the liver, and has actually been observed (Naunyn[‖]) in the smaller branches of the portal vein, and also by me in a case to be discussed later.

(*f*) By penetration of the wall of the vein by cells from a cancer in contact with it. This has been observed and described by Broca, and later by many others, and is often found to occur in the larger veins.

There is hardly any doubt that cancer of the veins, as a rule, if not always, starts by the walls of the vein being broken into by malignant cells from without. Sick[**] emphasizes the point brought out by Broca that when a malignant tumor surrounds the vein on all sides the vessel is usually pressed together, and obliteration of the lumen is the final outcome, but when, on the other hand, the tumor-cells first reach one side of the vessel, the tumor-cells may get time to penetrate the wall and enter the lumen while the circulation is still kept up, so that there results a filling of the lumen by cancerous tissue. When the malignant cells have once entered the lumen, growth continues, both with and against the blood-stream. The latter condition is especially frequent in the portal vein. This is due at least partly to the absence of valves in this vein, since the valves may interfere with the rapid extension of the cancer by preventing parts of the tumor from coming in touch with the vessel-wall peripherally to the occluded lumen.

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[*] Spaeth: *Loc. cit.*, p. 444.

[†] Virchow's Archiv, 1847, vol. i, p. 112.

[‡] "Seltene Beobachtungen an einer Krebskranken," Wien. med. Wochenschr., 1862, vol. xxiii.

[§] Beiträge zur Lehre von Venenkrebs, Tübingen, 1862.

[‖] "Ueber die Entwicklung der Leberkrebse," Arch. f. Anat. u. Physiol., 1866.

[**] *Loc. cit.*

While the tumor mass is advancing through the lumen of the vessel, adhesions between the tumor and the wall of the vein always occur, whether the growth is against the current and by thrombosis or with the flow of blood. The vasa vasorum form connections with the vessels of the tumor in a way in which a benign thrombus undergoes organization. The connection of the malignant growth and the vasa vasorum was first observed by Carswel. It is remarkable how very little tendency there is on part of the malignant growth to attack the vessel-wall from the inside, especially in the larger veins. In the smaller portal veins, especially in the liver, the walls are rapidly broken down from the inside.

Just how the cancer-cells entered the veins of the stomach in the case now under consideration is, as usual, impossible to demonstrate directly, since it is impossible to find the point of perforation. The walls of the smaller veins were thickened, but not to any great extent infiltrated by the carcinomatous cells. One thing observed which might throw some light on this was the fact that some of the walls of the smaller veins, as, for instance, the little veins of the muscularis, were infiltrated by cancer-cells near the main tumor mass, and these might well be cells in the act of breaking into the lumen from the outside, for there occur in one of the small veins of the muscularis infiltrating cells which are at least three times the size of the ordinary young connective-tissue cells (indifferent cells). These are without doubt carcinomatous cells, and they can be seen to extend entirely through the vessel-wall. This lymph-vessel would in this case have been filled with malignant cells, and it is possible that these might break through the lymphatic walls and then into the wall of the vein, and finally through this into the lumen.

In the edge of the ulcer were veins less than 1 mm. in diameter, which were filled with cancer-cells surrounded by a distinct stroma. Such small veins are easily overlooked, especially when only a few are present in a large tumor. But even one single vein of this type is sufficient to explain metastasis in the liver if found at a time when the circulation is uninterrupted. The flow of blood through the vein may be stopped at a later date by the formation of a thrombus or by the tumor compressing the lumen. When such is the case, cancer of the veins is not observed, since the malignant cells have not invaded the larger veins. Nevertheless, malignant emboli have reached the liver and developed into secondary tumors there. Sometimes these are very large, and this may be explained by assuming that they developed from emboli starting in such small veins, which later on were obliterated. Furthermore, it sometimes happens that the liver is the site of two distinct sizes of secondary tumors. That is, part of them are large and are older than others which are much smaller and more recent, suggesting that they originated from cancer-cells breaking into small veins at different periods.

This case is also of interest in that it shows that cancer may grow into the smaller veins of the mucosa and submucosa, for even if the involved vein in the muscularis had not suggested this, and the infiltration into its wall could be regarded as secondary or as coming from cancer in the veins, still, from the nature and extent of the cancer in the stomach, it is certain that the smaller veins in this case gave rise to the cancer of the veins, for there was not the slightest sign of infiltration either in the muscularis or in the serosa, and the enlarged lymph-nodes of the lesser curvature were several millimeters distant from the superior coronary vein, and lay nearest to the central part of it, which was not involved. Therefore, nothing found in this case is against assuming that the cancer in the veins developed in the following way: Cells from the primary tumor broke into one or more of the veins in the submucosa, grew along the lumina into the superior coronary vein, and then extended down into its other branches in the stomach. Such a mode of development is analogous to the usual thrombus formation, and it is not improbable that the advance of the cancer against the blood-stream was preceded by the formation of benign thrombi into which the malignant cells then grew.

It appears more plausible to me to assume that the cancer-cells first extended into the coronary vein, and then back into its branches, than that the extension took place by anastomosing vessels between the branches, although both modes of extension are possible, and definite proofs for or against either way cannot be obtained. But this is of secondary importance in the face of the established fact that the cancer originated in the gastric tumor, broke into the smaller veins around it, and from these developed along their lumina into the larger veins. There is no case in the literature establishing this relation in the portal system. In the greater circulation, on the other hand, analogous cases occur—for instance, a very instructive case by Wettergren.* He found cancer of the testicle which had broken into the veins of the pampiniform plexus, and from there into the spermatic vein. From this point the cancer-cells had grown into a small branch which did not drain the affected testicle. Hence the cancer did not grow against the blood-stream.

The type of cancer was in my case, as well as in that of Spaeth, medullary carcinoma. As far as I know, similar conditions have not been observed before in cylinder-cancroids,† but that it can occur will be plain from the following case, which Professor Reisz generously has turned over to me for publication:

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* Nord. med. Arkiv, 1872, vol. iv.

† Broca: Traité des tumeurs, Paris, 1866, p. 214, holds that epithelioma had not been seen to break into veins up to 1866.

CASE XXV.—*Cylinder-cancroid in the stomach; large superficial, flat, villous ulcerated tumor on the anterior surface of the stomach at the lesser curvature. Malignant thrombosis; cylinder-cancroid in the superior coronary vein and its branches, also in the portal vein. The thrombosis is continuous into the superior mesenteric vein and into the splenic vein. Marantic thrombosis of the inferior vena cava. Multiple tumors—cylinder-cancroids—in the liver. Ascites.*

P. Hansen, age fifty-three, foreman, had suffered from constipation and gastralgia for two months. He entered the hospital February 23, 1871. Inspection showed the veins of the lower abdomen to be distended. On palpation the liver was felt to be large and to have an irregular surface. He continued to lose flesh and to have pains in the stomach, but he never vomited. Toward the last he began to cough and have bloody expectoration. Death occurred on March 3, 1871, about eleven weeks after the first appearance of symptoms.

Autopsy by Professor Reisz, ten hours after death. The body is emaciated. Both lungs contain large infarcts, and in the branches of the pulmonary artery are found discolored emboli corresponding to the infarcts in the lungs. The abdominal cavity contains 6000 c.c. of a bloody, serous liquid. The peritoneum is pale. The liver is enlarged, weighs 4000 grams, and extends 2 to 3 cm. below the costal arch. On the surface of the organ, to the right of the suspensory ligament, are seen several tumors about 7 cm. in diameter. A similar growth occurs in the left lobe, and a number of smaller nodules occur partly around these larger growths, and partly some distance away from them. The liver parenchyma also contains similar tumors, which are more numerous and larger in the right lobe. There are no adhesions between the liver and the stomach. When the liver is lifted out of the abdominal cavity, a walnut-sized tumor is seen near the cardia. The stomach is distended with gas. On its anterior surface, at the lesser curvature, is a mass of outstanding veins which extend 5 to 6 cm. over the anterior and posterior walls. The lesser curvature, therefore, is surrounded by a mass of dilated veins which radiate over both anterior and posterior walls like a caput medusæ.

The veins have a yellowish color and are firm to touch. They appear as if they had been injected by some substance; their walls are also thickened, and in case of the smaller veins, the walls are studded with small, yellowish nodules resembling the dilated lymph-vessels found in the mesentery and on the serous surface of the intestines in cases of tuberculosis of the intestines. The portal vein at the hilum of the liver is dilated and contains a mass similar to bone-marrow. The veins of the stomach contain similar masses. The mucosa of the stomach is pale. A flat, slightly prominent tumor is seen on the lesser curvature. It has a villous surface, on which are numerous superficial ulcers. In some places soft cylindric masses can be expressed from the veins of the new-growth. In the mucosa and submucosa, at the periphery of the tumors, are found several smaller tumors of different sizes. On the inner surface of the organ occur masses of veins similar to those described on the outside. These are continuations of the former. The splenic vein is filled by a mixed thrombus, which is continuous into the superior mesenteric vein and extends into the portal vein, where it becomes paler and resembles more the bone-marrow. Hence the following veins are filled with malignant cells: Veins which run toward the lesser curvature, including the veins from the tumor; the superior coronary vein, which has a diameter of 5 mm., and even reaches a thickness of 1 cm. where it empties into the portal, which is also distended. The thrombus in the upper part of the superior mesentery and the splenic veins is benign. At the bifurcation of the inferior vena cava there also occur old firm thrombi. The rest of the organs are free from metastasis.

Microscopically, the soft plugs expressed from the small veins in the stomach have the structure of a cylinder-cancroid, partly degenerated. The main tumor itself is a typical cylinder-cancroid, as are the malignant thrombi and the secondary tumors in the liver.

As far as the development of cancer of the veins goes, this case, without doubt, represents a complete analogy to the case preceding it. Here too occurred veins in the primary tumor filled by malignant cells, and that the tumor was the source of these cells is highly probable, although it cannot be definitely proved, because the malignant thrombi might have originated in the large tumor near the cardia and broken into the superior coronary vein. Such a process could not be definitely shown. That the tumor masses extended from the superior coronary into the portal and did not originate in the latter is evident from the fact that the portal tributaries below the coronary vein were free from carcinoma and only contained benign thrombi.

(*b*) CASES IN WHICH THE CANCER MASSES GREW INTO THE VEINS FROM SECONDARY TUMORS AT THE LESSER CURVATURE

CASE XXVI.—*Mixed tumor of the stomach. Greater part consists of medullary carcinoma with medium-sized round-cells; few alveoli made up of columnar cells. Large, ulcerated, semisolid tumor in the pyloric end. No stenosis. Chronic catarrh with atrophy of the gastric mucosa. Malignant thrombosis of the superior coronary vein. The malignant thrombus protrudes slightly into the portal vein. Groups of cancer-cells in the portal blood. Malignant thrombi of the smaller branches of the portal. Multiple medullary carcinoma of the liver. Few larger tumors in the liver. Medullary carcinoma of the retroperitoneal glands. Cancerous infiltration of both vagi. Croupous pneumonia of the lower lobes of both lungs. Parenchymatous nephritis in second stage. Anasarca of the lower extremities.*

Hansine Hartwig, age sixty-three, married. Family history negative. For six months she suffered from severe pains in the right hypochondrium, and later also in the epigastrium and left hypochondrium. She also had nausea and vomiting immediately after meals. She gradually lost flesh and strength, and was forced to go to bed for about a half month before she entered the hospital, on the fourth of December, 1872. She was pale and emaciated. An irregular tender tumor was felt in the abdomen, extending from the right hypochondrium into the epigastrium and over into the left hypochondrium (the liver). She had violent exacerbation of pain, which could not be eased by opiates, and was most intense in the hypochondria and in the epigastrium, but radiated from these points over the entire abdomen. The vomit never contained blood. During the last month the pains decreased considerably and were absent for days at a time. They could not be controlled by narcotics. Toward the last edema appeared in both lower extremities and albuminuria. She died March 23, 1873, about eight months after the appearance of symptoms.

Autopsy, thirty-six hours after death. The peritoneal cavity is free from fluid. The liver reaches 4 to 6 cm. below the costal arch. Between the colon and the abdominal wall on one side, and the mesentery, on the other, are cord-like adhesions, and the gastrocolic ligament is thickened and retracted, but there are malignant nodules on the peritoneum. Below the left lobe of the liver is a tumor as large as an adult fist. This is the enlarged pyloric end of the stomach which is firmly adherent to the liver, and on its peritoneal surface occur small tumors which are flat and of a white color. Between them are injected lymph-vessels. The stomach is not enlarged, but rather decreased in size. In the pyloric end is a large malignant ulcer, 8 cm. wide and 8 cm. in height, beginning 1 cm. from the sphincter. The ulcer is situated on the posterior wall, but does not extend completely around the pylorus. The ulcer has highly infiltrated edges, which are very irregular and semisolid. Its cut surface is grayish white, and a purulent fluid can be expressed from it. Along the lesser curvature in the submucosa are found numerous movable tumors, varying in size from a hempseed to that of a pea. The rest of the mucosa is slate colored, but thin, and its veins are somewhat dilated. The mucous membrane of the duodenum is slightly pigmented, but otherwise unchanged.

The posterior wall of the stomach and the half of the lesser curvature facing the cardia are grown together into a conglomerate mass of hen's-egg-sized tumors, which surround the inferior vena cava and the aorta. On the right posterior vagus, behind the cardia, where the nerve passes into the tumors, is found a firm, spool-shaped tumor, 2 cm. long and 4 to 5 cm. in width. A larger branch of the anterior vagus is seen to end as a similarly shaped, firm tumor, connected with the tumors in the stomach. The hepaticoduodenal ligament is retracted, and the pyloric end is firmly adherent to the posterior surface of the left lobe of the liver. There are hen's-egg-sized tumors in the hepatic hilum. In the portal vein, immediately behind and above the pancreas, is a carcinomatous tumor as large as a nut. This forms the mushroom-shaped end of a malignant thrombus that fills the left coronary vein from the stomach and extends into the portal vein. The malignant thrombus can be followed to the tumor on the lesser curvature, where the vein is lost in the tumor mass.

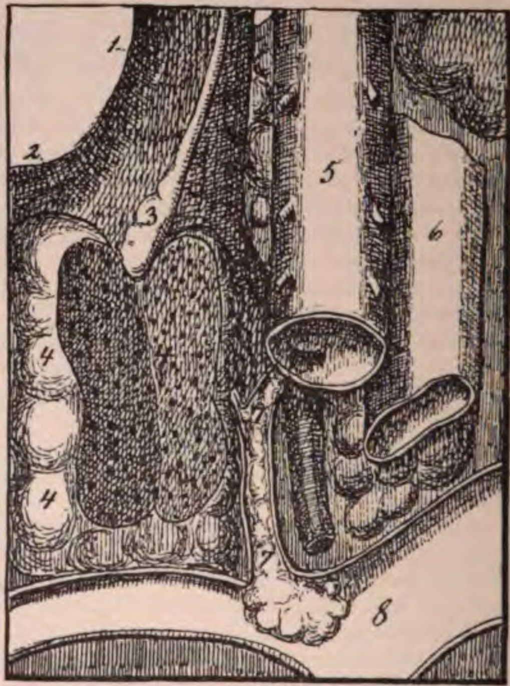

Fig. 9.—1, Esophagus from behind; 2, stomach from behind; 3, club-shaped neuroma on posterior vagus at its entrance into 4, tumor mass on posterior surface of stomach; 5, aorta; 6, inferior vena cava; 7, superior coronary vein filled with tumor mass, which projects into 8, portal vein.

The liver is markedly enlarged. In both lobes occur numerous nodules, varying in size from a pinhead to that of a nut. In addition to these the right lobe contains three tumors as large as a goose-egg, and the left lobe one the size of an adult fist, situated at the point where the pyloric end is adherent to the liver. Between the smaller tumors on the surface are seen, in a few places, injected branches of the portal vein. In cross-section none of the larger branches of the vein are involved, but from the smaller branches (½ mm.

in diameter) small white cylindric plugs are expressed, and where these veins empty into the larger, are found button-like ends of the malignant thrombi in the small veins. The glands along the esophagus are not involved, and the rest of the body is free from metastasis. Microscopically, the white juice expressed from the cut surface consists of detritus, fat-globules, granular pieces of round-cells, and flat, round, medium-sized cells having large round nuclei. The thrombi in the portal branches consist of similar elements mixed with blood-cells. The portal blood is of normal color, but contains numerous cells, partly isolated and partly collected into groups. These are large, granular round-cells which have sharply circumscribed nuclei. The blood of the hepatic vein is free from cancer-cells.

Microscopic structure: The slate-colored mucosa is atrophied, only 0.3 mm. in thickness. The glands are scant; only here and there occurs a gland fundus of normal size, filled with a granular mass. The edge of the ulcer in the stomach is lined with a macerated mucosa, and it consists of a highly granular stroma containing groups of small alveoli filled with medium-sized round nuclei. A few of the alveoli are covered with a layer of short cylindric cells. The swollen parts of the vagus consist of a tumor mass made up partly of groups of polymorphous, medium-sized cells, which penetrate between the nerve-fibers; part of the structure is made up of cancer tissue with a distinct alveolar stroma. In places in this mass the nerve-fibers are separated; nearly all are finely granulated. The nerve-stem above the infiltrated portion shows practically no degeneration. The tumor mass in the coronary veins is also medullary carcinoma, as are also the nodules in the liver.

The malignant involvement of the vagi will be taken up in detail later; for this reason I shall pass it by here.

It is of interest to know that in this case the malignant cells were seen in the act of growing into the stem of the portal vein, which was still patent. Hence there was neither ascites nor splenic tumor. There is no doubt that if the lobar pneumonia had not carried the patient away, the tumor mass would have occluded the portal vein and finally grown up around it to such an extent that it would have been impossible to prove that the cancer originated from the portal vein. For this reason the case offers valuable proof for the idea that when cancer of the portal vein and of the stomach are present simultaneously, and when there is no cancer of the veins of the stomach, the cancer may have spread in the usual way from the coronary vein into the portal. From the malignant thrombus protruding into the vein, masses of malignant cells were continually being washed into the portal vein, as was proved by the content of the portal blood. These malignant emboli occluded the smaller branches of the portal, which appeared as injected veins on the surface of the liver, and contained thrombi protruding into the larger veins.

At first the tumors in the liver have a characteristic grouping which Meyer considered a sign of phlebitis, because of their similarity to beginning abscesses in pylephlebitis. But this form is also found as the initial stage of metastatic abscesses, and will be found in any degenerated process originating in the smaller vessels.

The following case is completely analogous to the previous one, so far as the origin and development of cancer of the vein go, and shows in addition that malignant emboli may become adherent to the large branches of the portal vein:

Case XXVII.—*"Cylinder-cancroid" in the pyloric end, with stenosis. Medullary carcinoma in the superior coronary vein, the portal vein, the liver, and in the pouch of Douglas. Polyp and fibroma of the uterus. Left suppurative oöphoritis. Thrombosis of the crural and the uterine veins. Pachymeningitis interna.*

Oline Nielson, age fifty-one, seamstress. Autopsy, twenty-four hours after death. The abdominal cavity contains about 100 c.c. of a clear serous fluid. The peritoneum is to a slight extent diffusely thickened, but otherwise unchanged, with the exception of a soft tumor at the bottom of the pouch of Douglas, the size of a walnut. In the neighborhood of this tumor occur a number of small, flat tumors, similar in appearance to the larger. The stomach scarcely holds 1500 c.c. of fluid. On the posterior wall of the pyloric end of the stomach is a malignant ulcer, 5 cm. in length, which extends partly around the pylorus, leaving a narrow belt on the anterior wall free from infiltration. The bottom of the ulcer is rather smooth, and consists of infiltrated muscularis. The edges of the ulcer are distinctly raised and uneven, and are made by a cancerous infiltration of the submucosa and the muscularis. The cut surface of the edge is soft and contains white areas. It gives a large amount of whitish fluid on pressure. The infiltration extends more than 1 cm. down into the duodenum, but there are no visible lymph-vessels in the villi or the submucosa. The lesser peritoneal cavity is filled with a soft, nearly liquid, brownish-red cancer mass, in which occur numerous ecchymoses.

The tumor seems to have arisen from the retroperitoneal glands, and is adherent to the small curvature and posterior wall of the stomach. In the portal vein, where it passes in front of the pancreas, is an adherent coagulum 2 cm. in length, containing white masses; a little higher up, in the hilus of the liver, the portal vein contains a yellowish-white, soft, adherent cancer mass, 3 cm. long and 5 mm. in thickness, which continues into the branch to the right lobe, the ramifications of which appear as if injected with a cancer mass.

The liver is somewhat enlarged; on the surface are found numerous somewhat prominent, often rounded nodules, varying in size up to that of an orange; they lie in groups closely together and are quite soft. In the smaller branches of the portal vein are found numerous small emboli which look just like the contents of the tumors. Along the abdominal aorta the retroperitoneal glands are infiltrated with cancer. The tumor in the stomach is a "cylinder-cancroid." The tumors in the liver and the fossæ of Douglas are medullary carcinomata. The tumor masses in the portal vein are also medullary carcinomata, the stroma arising from the inner wall of the vessel. The most peripheral mass in the main branch of the portal vein lies opposite the entrance of the coronary vein of the stomach; this vein is filled with cancerous material up to within 1 cm. of the entrance, and disappears in the tumor mass at the small curvature. In the smaller branches of the portal vein are cancer-cells of the same size and appearance as the cells in the tumors.

In this case the closure of the portal vein was partial, and consequently there was neither ascites nor splenic tumor. The tumor in the portal vein, as well as the other metastases, were medullary carcinoma, while the tumor of the stomach was "cylinder-cancroid." As already mentioned, this condition is found not unusually in these forms of tumors.

The third and last of this series of cases of cancer in the portal vein is of especial interest, because cancerous growth extended clear out into the small superficial branches, the relation of which to the secondary tumors in the liver was visible with the naked eye.

Case XXVIII.—*Mixed tumor, predominatingly "cylinder-cancroid." Medium-sized, ulcerated tumor in the pyloric end, near the small curvature. Erosion of the right superior coronary artery, with profuse hemorrhage. Rupture into the peritoneal cavity and peritonitis. Cancerous thrombosis in the superior coronary vein, from which the cancer extends into the* *main stem of the portal vein, into the splenic vein, and into the branches of the portal vein, passing to the right lobe of the liver. Multiple tumors of the liver. Single cylindric epithelial cells.*

Maria Köhler, age forty, married. Autopsy twenty-four hours after death. The body is well nourished. Rigor mortis present. The superficial veins of both legs are somewhat varicose, and the right long saphenous is varicose throughout its entire length. The peritoneal cavity contains 1000 c.c. of fluid, in which are yellowish, flocculent masses. Purulent material can be scraped from the parietal and visceral peritoneal surface. On the anterior wall of the stomach, near the lesser curvature, and 5 cm. from the pylorus, is a pea-sized perforation through which the contents of the stomach exude. The stomach is contracted, but not enlarged. The pyloric end is firm and infiltrated, and between the lesser curvature and the hepatic hilum is a mass of firm tumors to which the lesser curvature is adherent. The fundus and the body of the stomach are normal in shape and size. In the pyloric end, which is not noticeably narrowed, near the lesser curvature, is a round, flat ulcer, which is 6 cm. in diameter, and has a firm, infiltrated, wavy edge, 5 to 7 mm. in thickness, which arises perpendicularly from the bottom of the ulcer. The ulcer is firm, somewhat uneven, and of a grayish-white color; in the center occurs what appears to be the lumen of an artery, cut across obliquely, which is about 1 mm. in diameter, and through it a sound can be passed 7 cm. up into the hepatic artery. The ulcer extends to within 1 cm. from the pyloric sphincter, and right below, in the submucosa of the duodenum, is a flat nodule. The mucosa of the stomach is diffusely thickened and thrown into grayish, non-transparent folds, but it is free from cancerous growth.

In cross-section of the edge of the ulcer there is found in the submucosa a white, semisolid, thick ring of cancerous tissue; the cut surface is smooth; from it can be scraped a milky juice consisting of granular columnar cells, pieces of cells, fat-globules, débris, and a few individual flat cells. In the center of the ulcer occurs the perforation already mentioned, which has smooth edges. The pancreas is enlarged, especially its head, and between the lobules of its parenchyma occur white spots from which soft white plugs, consisting of columnar cells, can be expressed. These spots are malignant thrombi in the veins of the organ, and have originated from a single large thrombus occluding the splenic vein, and extending into the portal vein, which is enormously dilated, and forms a sac 2 to 3 cm. in thickness, filled with a brain-like cancerous mass. This extends only 1 cm. below the splenic vein, but runs up into the hilum of the liver and into the right lobe of this organ. The larger branches of the portal in this lobe are entirely occluded by malignant cells. But the cancerous mass does not extend as a continuous thrombus into the branches of the left lobe. In this lobe are two small masses lying loose in branches of the portal vein.

From the smaller veins can be expressed a thin, reddish, serous fluid, consisting of red and white cells mixed with numerous columnar cells, which occur either singly or in groups. The liver is slightly enlarged. On the surface of the right lobe is one whitish-gray, soft tumor, the size of a hen's egg, and four as large as walnuts. These are somewhat sunken in the center and semifluctuating. Surrounding them occur numerous whitish-gray, slightly prominent, star-shaped spots, about as large as peas, and from these extends a white, injected network of veins, which runs underneath the superficial lymph-vessels. This network is formed by the peripheral branches of the portal vein, which in cut section are seen to be dilated to twice their normal size, and everywhere filled with cancerous masses. The blood in the hepatic vein is thin, light red, and of a serous character. Besides the normal contents, in the usual proportion, it contains a few individual columnar cells. The retroperitoneal glands, the vagi, and the thoracic duct are unchanged. The spleen is markedly enlarged, and measures 16 cm. in length, 20 cm. in width. The splenic pulp is firm, tenacious, of a chocolate color, and free from metastasis. The lower lobes of both lungs are somewhat edematous. The heart is normal.

Microscopically, the mucosa of the fundus of the stomach is 0.8 mm. in thickness;

the glands are distinct, and the nuclei of the cells are visible without the addition of acetic acid. The mucosa on the edge of the ulcer is not villous.

Some of the glands are 4 or 5 times their normal size, but cannot be traced through the muscularis mucosæ. This is markedly infiltrated with small round-cells, and the tumor mass in the mucosa contains similar larger cavities, *i. e.*, alveoli, which are arranged in groups and lined with columnar cells, and usually filled with granular detritus. There are a few individual alveoli filled with round-cells. The bottom of the ulcer is formed by a firm white connective tissue, in which occur a few alveoli lined with round-cells. These as well as the stroma are finely granular toward the center of the ulcer. The lymph-glands contain groups of alveoli, some of which are lined with columnar, others with round-cells.

The tumor mass in the portal vein is very soft and is difficult to harden in chromic-acid solution. It can plainly be seen to have originated from a similar mass in the superior coronary vein, because bundles of stroma extend into the tumor in the portal vein and up toward the liver and down into the mesenteric vein. The coronary vein can be traced only 1 cm. toward the pylorus, at which point it is taken up and destroyed by the tumor at the lesser curvature. The structure of the malignant growth in the vein consists of a granular, often degenerated stroma of connective tissue, in which occur larger alveoli lined with columnar cells, and smaller ones containing polymorphous cells. There are no cancerous cells in the walls of the portal vein. The smaller branches of the portal contain the same kind of tumor-cells, and a stroma springing from the wall of the vessels, in the external coat of which there is often round-cell infiltration, but no tumor-cells. In a few places the vessel-walls are thick, because of the round-cell infiltration; in other places they are thin, and their individual coats cannot be distinguished from the layer of connective tissue which is often present between the liver masses and the parenchyma. In the minute veins are also cylindric carcinomatous growths with stroma from the walls. The stroma originates from a broader basis, into which the nuclei of the vessel-walls extend.

The walls of many of the smaller veins are destroyed, and the cancer mass has extended into the liver parenchyma. The smallest branches of the portal contain finely granular, degenerated, benign thrombi. Acute interstitial hepatitis is present everywhere in this part of the liver, and thick bundles of the connective tissue, rich in small round-cells, occur between the acini. The tumors in the liver are cylindric carcinomata, containing smaller and larger irregular groups of alveoli. The liver parenchyma is soft, markedly degenerated, and difficult to harden. The tumors are surrounded by layers of connective tissue, outside of which the liver-cells are compressed and undergoing atrophy.

There is no doubt that in this case the tumor mass had grown into the portal vein from the superior coronary vein, since the mouth of this was shown to be the center from which radiated the tumor mass in the stem of the portal. The wall of this vessel was not involved by the cancer-cells, even in places where the larger tumors were in close contact with them. The occlusion of the portal had caused a considerable tumor of the spleen, but not a pronounced amount of ascites, which in this case was masked by the perforative peritonitis. Part of the thin exudate present, of course, might have been due to the ascites having become cloudy by the peritonitis.

The pronounced dilatation of the portal vein and its being filled with cancerous mass extending out to the minute branches are of extreme interest. When one considers that the smaller branches probably are dilated to twice their normal size, it becomes apparent that malignant cells with distinct stroma from the vessel-wall extended out into the venules about 0.5 mm. in diameter.

As seen from Fig. 10, the development of the small growths of cancerous tumors in the liver can be traced readily from the peripheral, dilated branches of the portal vein. There occurs underneath the empty superficial lymph-vessels at 1 a white, injected network of veins, the smallest of which joins the dilated larger branches at 2. Some of these at 3 are so extensively dilated as to form nearly round tumors, the size of small nuts. From all sides of these extends a network of veins. There are all gradations from these to the small round tumor at 4. Some of these transitional masses have a couple of small extensions—5. Others have simply a dentate periphery, which suggests the former (see 6). Such a distinct picture is very rarely seen, and injection of the small portal branches has, as far as I know, been described only by Spaeth. As a rule, the shape of the tumors is irregular and the periphery dentate, a form that points to their origin from the vessels.

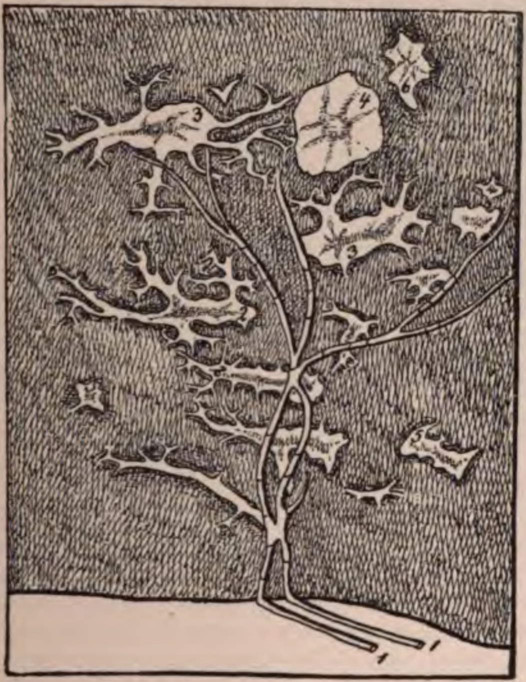

Fig. 10.—Surface of liver, with injection of branches of portal vein (2–6) and empty lymph-vessels (1, 1).

The changes which the walls of the smaller veins undergo when the cancerous masses break through and infiltrate the liver parenchyma are as follows: There first occur in the walls numerous small round-cells, producing a thickening of the vessel-walls. The muscular fibers and the elastic tissue disappear, and the wall now consists of a layer of young connective tissue into which the malignant cells force themselves, so that it becomes impossible to distinguish the vessel-wall from the layer of young connective tissue which surrounds the malignant tumors that did not originate from the veins. Coincident with this change in the texture of the walls the vessel dilates, and its walls become sacculated; because of the transformation into young connective tissue it becomes impossible to decide whether the dilatation took place at the point where the wall was broken through by the cancer-cells, since this now cannot be distinguished from the ordinary young stroma.

The smallest veins, the interlobular, contain degenerated coagulated blood consisting of a granular detritus. This produces a chronic inflammation of the interlobular connective tissue, which becomes infiltrated with small round-cells and undergoes hypertrophy in the same way as in cirrhosis of the liver.

The series of 5 cases described show that cancer of the stomach rather frequently extends into the veins—first into those of the stomach itself, then into the portal, and finally is disseminated in the liver. In order that the liver may become the seat of secondary malignant growths, in these cases, where the peripheral branches of the portal and its roots are filled with malignant thrombi, the stem of the portal must be patent. In other words, when the central part of a vein is occluded, metastasis from a malignant thrombus at its periphery becomes impossible. That such is the case is so regularly conceded that I would not have mentioned it if pathologic observations along this line had been recorded. This is, as far as I know, the case, and I shall, therefore, cite the following interesting case,* which throws light on this point:

Medullary carcinoma in the fundus of the stomach which is adherent to the spleen and into which the tumor has grown. Cancerous thrombosis of the portal vein. Large cancerous lymph-glands in the hepatic hilus. Compression of the portal by these tumors. No metastasis in the liver. Multiple carcinomata on the stomach, the spleen, the diaphragm, and the liver. Ascites. Peritonitis. Icterus.

Lars Mathiesen, age fifty-eight, laborer. Autopsy, July 14, 1874, thirty-six hours after death. The peritoneal cavity contains 10,000 c.c. of a cloudy, icteric fluid, in which occur numerous yellow, flocculent masses. The peritoneum covering the intestines and lining the abdominal wall is injected, uneven, and covered with a fresh fibrinous exudate. The spleen, the diaphragm, and the left lobe of the liver are adherent to the stomach, which is of usual size and shape. In the lesser omentum are several soft medullary tumors. The stomach contains a reddish-gray, thick fluid. In the fundus, which is adherent to the spleen 3 cm. below the cardia, is an irregular tumor the size of a flat hand, having an irregular, in some places markedly infiltrated, edge, which consists of soft masses which microscopically appear to be carcinomatous, containing middle-sized polymorphous cells. The central part of the tumor has sloughed away, and forms an opening leading into the spleen, in which is found a cavity the size of an adult fist, filled with a reddish-gray liquid. Between the cavity and the splenic pulp is a belt of cancerous tissue, and scattered through the spleen in other places occur a few small malignant growths. In the connective tissue which fastens the spleen to the diaphragm are numerous irregular tumor masses, and on the adjacent parts of the peritoneum occur groups of cancerous tumors as large as hempseeds. The part of the splenic vein which lies in the pancreas is dilated and filled with a semisolid, grayish mass, which has the same appearance as the malignant growths in the stomach, and where, under the microscope, is a medullary carcinoma. This thrombus extends 1 cm. into the portal vein. The lower part of the portal stem and its tributaries from the mesentery contains liquid blood; their walls are normal. The upper part of the portal stem in the hilum of the liver is compressed by a mass of carcinomatous tumors, and the lumen of the vein is obliterated for a distance of 2 cm. at this point, due to the fact that the intima, being compressed by the tumors, has grown together. In the middle of the obliterated portion the vessel-wall is indistinguishable from the tumor mass. In the portal branches of the liver is a slight amount of liquid blood, but no thrombi or cancerous masses. The liver is of normal form and shape. On its surface occur scattered white, semisolid, pinhead-sized nodules (carcinomatous) that extend down into the liver parenchyma. This contains a medium amount of blood, is slightly icteric, but otherwise normal, and is free from metastasis. There are no metastatic growths in the rest of the organs.

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* This case was not given in the list of my cases, since I ran across it at an autopsy during the writing of this dissertation.

There is hardly any doubt that this obliteration of the portal vein was present before the malignant cells broke into the splenic vein, and hence prevented the formation of metastasis in the liver, for if the portal had been patent at that time the liver would, in this case, as in the others already mentioned, have been the seat of cancerous growths, which in such cases very often are of considerable size.

Through the portal capillaries the liver prevents the further advancement of the tumor-cells, and nearly always forms an insurmountable barrier, preventing the cells from entering the greater circulation, and the metastasis in organs supplied by this part of the blood. The liver capillaries form, as it were, a filter, which holds back the malignant cells from the thrombi, and for this reason none of my cases shows secondary growths in the lungs.

This fact strongly supports the theory, which now is more and more coming to the front, that secondary cancerous involvement of organs is produced by malignant cells alone, and not by substances in solution, for if soluble substances could produce metastasis, these could readily pass the portal capillaries and be carried to organs supplied by the greater circulation. Furthermore, one cannot conceive of a better opportunity for infective substances in solution to enter the blood-stream than the one given when the blood-stream continually washes over a young, soft, fresh tumor-mass protruding into the veins. For this reason the cells torn loose from the malignant tumor must possess the ability to produce secondary growths, and these cells are, as a rule, too large to pass the liver capillaries, but even if they were as small as the white blood-corpuscles, they must be too firm to undergo the changes of form which facilitate the passage of the former through the smaller blood-capillaries.

In one single instance (Case XXVIII) I found, to be sure, columnar ells in the blood of the hepatic vein, but I dare not place much weight on this observation, since both the lungs and the rest of the organs supplied by the greater circulation were free from metastatic growths. That small columnar cells singly might pass through the capillaries when they are continually floating in the blood-stream is not inconceivable. But, as has been mentioned, the absence of metastasis speaks strongly against this; besides, it is quite possible that a few columnar cells might get into the blood when it is removed, even though one is ever so careful, since all the surroundings, both smaller and larger branches of the hepatic vein after removal and cross-sections of the organs, are covered with columnar cells by the thousands.

The foregoing cases furthermore show that there is no special difference between medullary carcinoma and "cylinder-cancroid," so far as their ability to penetrate into and extend along the lumen of the vessels goes. In Cases XXV and XXVIII the structure was "cylinder-cancroid" and mixed. In Case XXVI and XXVII the primary tumor was a mixed form of "cylinder-cancroid," while the carcinoma in the vein was, as one would expect, of the same structure as that of the secondary growth from which it originated, namely, medullary carcinoma. In Case XXIV both the primary tumor and the malignant thrombi were medullary carcinomata. Hence it is plain that the medullary carcinoma, notorious for its ability to get into the veins, is not any more malignant than is the "cylinder-cancroid" and the mixed types.

THE EXTENSION OF CANCER THROUGH THE LYMPH-VESSELS, THORACIC DUCT, AND THE CONNECTIVE TISSUE OF THE LIVER

(*A*) *The Lymph-vessels.*—It is well known that the lymphatic glands are the most frequent sites of secondary malignant growths. It is, therefore, natural that attention early was directed to the lymphatic vessels as the channels through which cancer spreads from the primary growth into the surrounding and into other organs. On organs covered with serous surfaces it is easy to observe the lymph-vessels, which contain a cloudy fluid. For this reason it is in organs like the lungs or those of the peritoneal cavity that cancer masses have been most frequently observed in the lymph-vessels.

Andral[*] was one of the first to observe that lymph-vessels coming from ulcerated carcinoma of the stomach contained purulent masses. Cruveilhier[†] gives a picture of an alveolar carcinoma in the pyloric end, the peritoneal surface of which was covered with pinhead-sized granulations, and some of these were arranged in a regular fashion, so that the figures corresponded to the lymph-vessels. He did not believe that the cancer in these vessels had come from without, but thought it had originated inside. In these, as in other cases, the content of the lymph-vessel was not examined microscopically, and hence it might have been simply a stagnation of the lymph, due to clogged-up lymph-glands below.

Later observers have not supported the views held by the older writers regarding cancer of the lymph-glands. Lebert[‡] found cancer juice in the lymph-vessels on the surfaces of the lungs, the liver, and the mesentery. Rokitansky[§] states that the lymph-vessels often contain cancerous masses from lymph-glands undergoing malignant degeneration; that this, as a rule, has the structure of medullary carcinomata, but might also be epidermal cancer. In such cases he has seen, on the inside of the lymph-vessels, "papilläre Bindegewebeswucherungen," which he thinks serve the purpose of stroma for the cancer-cells in this place. Klinger* found injected lymph-vessels on the surface of the liver in a case of carcinoma of this organ, and also on the surface of the stomach in an instance of cancer of the pylorus. The lymph-vessels appeared on the involved organ as a network, holding dilated spaces which were filled by carcinomatous tissue. He thinks that metastasis, as a rule, is due to extension through the lymph-vessels. Broca† gives a picture of a dilated lymph-gland filled with malignant cells from a carcinomatous axillary lymph-gland. He believes that the malignant cells destroy the walls of the lymph-vessel, and from this point extend out into the surrounding tissue of the gland. Virchow‡ states that it is not unusual to find the lymph-vessels to a great extent filled with cancerous masses, both in "carcinoma and cancroid," and also in other forms of tumors, for instance, chondromata. In such cases the original tumor sends branches, as it were, out into the lymph-vessels, the walls of which eventually burst, so that the malignant cells enter the surrounding tissue. As an example of the latter condition he mentions a case of "cancroid" in the uterus where the lymph-vessels in the peritoneum and in the lungs, in the region of the degenerated bronchial glands, contained cancer plugs which in a few places had left the lumen of the vessels and were found in the peritoneal cavity and in the bronchi as free, worm-shaped masses made up of malignant cells. He concludes that cancer may extend through the lymph-vessels in two ways, viz., by cells loosened from the end of the tumor masses which grow into the lymph-vessels, being carried in the lymph-stream to the nearest lymph-glands; or the malignant masses might spread to the body cavities, where the lymph-vessels empty by masses of malignant cells breaking through the mouths of the vessels and emptying into the cavities. But, on the whole, he thinks cancer rarely extends through the lymph-vessels under any circumstances, since there often occur patent lymph-vessels containing only fluid between the primary tumor and the degenerated lymph-glands. Förster§ states that at times lymph-vessels from soft degenerated carcinomata are filled with cancer juice. He believes that this has entered through the open mouths of eroded lymph-vessels in the same fashion as does the lymph. He also holds that the malignant cells simply play a passive rôle in entering the lymph-vessels. But Virchow thinks that the malignant cells might grow into them.

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[*] R. Prus: *Loc. cit.*, p. 53.

[†] Anat. Pathol., Livr. 10, Pl. 3, Fig. 2, p. 4.

[‡] *Loc. cit.*, p. 76.

[§] Handbuch der pathol. Anat., vol. ii, p. 387.

Very recently attempts have been made to show that the lymph-spaces and lymph-vessels in the tissues of the organs take a considerable part in the local extension of cancer by groups of cells growing into the lymph-spaces, and then spreading through them. Ranvier* saw epithelial cell masses in the alveoli which were in direct connection with the lymph-spaces in a case of carcinoma of the mammary glands. These were in the surrounding granulation tissue, and he has seen such spaces empty into a lymph-vessel lined with epithelium. Furthermore, he observed that by inserting a Pravaz syringe into the tumor mass, he could fill the lymph-vessels leading from it by a colored fluid (a solution of Berlin blue and glycerin). If this condition occurs, as a rule, during the growth of a cancerous tumor, it is easy to explain metastasis to the lymph-glands by assuming that the malignant cells enter the lymph-vessels from the lymph-spaces and are washed by the lymph into the surrounding glands. Investigations of the Ranvier type are, however, possible only in relatively fresh tumors, and for this reason I failed to demonstrate it by his method in cases of cancer of the stomach.

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* "Bericht über einige Leberkrankheiten," Virchow's Arch., 1857, vol. xii, p. 538.

† *Loc. cit.*, p. 270.

‡ Oncologie, Heft 1, p. 52.

§ Handbuch der patholog. Anat., vol. ii, p. 800.

Köster† goes a step further with regard to the part played by the lymph-vessels in the spread of cancer, and claims to have found that cancer may develop inside of the lymph-vessels themselves by proliferation of the epithelial lining. He gives two cases—an epulis and a tumor in the orbit—in which malignant masses of cells occurred in the form of a network, thus simulating the lymph-vessels. The threads of the net consisted of epithelial cells, and in the center of the strings he observed a finely granular coagulum which he thought was coagulated lymph.

I have never seen anything similar to this in my cases of carcinoma of the stomach.

In the cases I have investigated of cancer of the stomach malignant cells were not very frequent in the lymph-vessels. I found only three instances where the serous surface outside of the tumor mass contained a whitish, injected network of slightly dilated lymph-vessels. This network consisted partly of perivascular spaces forming a whitish, slightly uneven border around or alongside of the smaller lymph-vessels, and partly of the lymph-vessels themselves, which formed a small-meshed right-angular network between the vessels. The first case was a mixed tumor, partly "cylinder-cancroid" and partly carcinoma. It formed a girdling ulcer extending almost around the pyloric end, the serous surface of which contained whitish, injected lymph-vessels holding columnar cells. These were partly well developed and of the usual form, with sharply cut-off ends, and partly cuboid cells, and finally a number of irregular cells. All three forms had a large oval, distinctly outlined nucleus, hence were of epithelial character and were not lymph-cells. The second case was an instance of cancerous extension into the nerves (Case XXXI, to be described later). This, too, was a mixed tumor, forming an ulcer on the lesser curvature, and on its serous surface the lymph-vessels were filled with a rather solid mass, consisting of round or angular polymorphous cells with large nuclei. The third case (from which the picture is taken) was a medullary carcinoma in the pyloric end, which is to be described later as Case XXIX. In this the lymph-vessels contained a mixture of lymph-cells and larger round epithelial cells with large nuclei.

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* "Étude du Carcinome a l'aide de l'impregnation d'argent," Arch. de physiol. norm. et pathol., 1868, vol. i, p. 666.

† "Cancroid mit hyaliner Degeneration," Virchow's Arch., 1867, vol. xl, p. 468.

I found cancerous cells in the lymph-vessels only once on a serous surface outside of the tumor mass. This was also in Case XXIX, in which the somewhat edematous infiltrated submucosa of the duodenum contained visible yellowish-white branched strings under a superficial cancerous infiltration of the mucosa. They were filled with a mixture of lymph-cells and epithelial cancer-cells. A similar case is reported by Waldeyer* from Vys. In a case of cancer of the pylorus he observed that chylous vessels in the villi of the surrounding parts of the duodenum were packed with epithelial cells. From the base of the crowded villi there extended through the mucosa, submucosa, and into the muscularis numerous "Strassen" of epithelial cells. These formed figures which were very similar to the course followed by the lymph-vessels in the intestinal walls.

In these two cases of cancer-cells in the lymph-vessels I failed to find their walls changed in any way. As far as these cases go, I am inclined to believe, with Virchow and Cornil, that cancer-cells from the tumor grow into the lymph-vessels, and, as Förster thinks, are carried further by the aid of the lymph-stream.

An actual growth of the cancerous tissue into the lymph-vessels, similar to that taking place in the veins, which may contain cancer tissue with stroma and vessels, has never been observed. The lymph-vessels, therefore, play a more passive rôle than do the veins. The lymph-vessels are rarely filled with tumor-cells, but one must assume that cells are carried in small numbers, by the vessels, into the glands.

(*B*) *Thoracic Duct.*—Although the thoracic duct contains the lymph from the larger cavities, the organs of which are so frequently the seat of carcinoma, and although carcinoma attacks the individual groups of lymph-glands in order from the periphery toward the duct, it is very rare that this becomes involved by cancer-cells or plays any rôle in the further extension of it. This becomes all the more strange when one recalls that the retroperitoneal lymph-glands, both in cancer of the stomach and in that of the other abdominal organs below it, often become the seat of large secondary tumors in the very neighborhood of the cisterna chyli.

From the scant information I have gathered from the literature I wish to give the following:

Andral† found the thoracic duct dilated in a woman with cancer of the uterus. It was thickened and contained a purulent liquid. The lymph-vessels between the inguinal glands were also dilated, and contained lymph and whitish masses which could readily be expressed from the open vessels. In the lumen of the thoracic duct occurred numerous round, grayish-white, and irregular masses, which were not adherent to the wall. It is not without reason to doubt, as Walshe‡ does, that the cancer of the uterus in this case had passed through the retroperitoneal glands and into the thoracic duct, partly for the reason that microscopic investigation did not definitely describe what the white masses in the duct were, and partly because these masses were not in any connection with the wall.

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* Virchow's Arch., 1868, vol. xli, p. 505.

† Anat. Pathol., vol. ii, p. 445.

‡ Walshe: *Loc. cit.*, p. 375.

Cruveilhier* states that he has found cancer juice in the thoracic duct once.

Dittrich† reports a dependable case of this type. In a woman fifty years old with cancer of the stomach and the liver he found that the thoracic duct at its origin consisted of several firm, infiltrated strings filled with cancerous masses. Farther up in the posterior mediastinum a portion of the duct 3 cm. in length was dilated to the thickness of a finger and filled with cancerous masses. Virchow‡ has never seen anything similar, but states that Buez,§ in the lymph of the thoracic duct, found elements which were very similar to cancer-cells.

Because of the scanty observations,‖ the following case is of peculiar interest, in that it is the only one on record in which malignant degeneration of the thoracic duct has been demonstrated beyond doubt:

CASE XXIX.—*Medullary carcinoma with large round-cells; flat ulcerated tumors on the anterior wall of the pyloric end. Injected lymph-vessels on the serous surface of the stomach and in the submucosa of the upper part of the duodenum. Medullary carcinoma of the peritoneum, both pleuræ (the part covering the diaphragm), and of the lower surface of the left lung. Carcinoma of all lymph-glands from the Fallopian ligaments up into the left supraclavicular fossa, and of the glands in the hepatic hilum as well as of those of the mesentery. Multiple tumors in the left psoas muscle. Carcinomatous infiltration of the hilum of both kidneys, around the gall-bladder and gall-tracts, and along the branches of the portal vein. Icterus. Multiple tumors in the liver. The walls of the inferior vena cava and the thoracic duct broken down by malignant cells, the lumina occluded by cancerous masses, and multiple tumors in the walls. Malignant thrombosis of the left innominate, the subclavian, and the left common jugular veins.*

P. Hansen, age fifty-four, laborer. Autopsy, twenty-four hours after death. The body that of a strongly built, but markedly emaciated man, 163 cm. in length; the skin and the sclera not icteric; rigor mortis present. The pericardial cavity contains a slight amount of a yellow, serous fluid. The heart is small, the myocardium somewhat soft and granular; the cross-striations are visible. The right ventricle is a trifle enlarged, and forms as much of the apex as does the left. Both ventricles contain many colorless coagula. The endocardium and the valves normal. The right pleural cavities contain about 500 c.c. of a yellowish, thin, serous fluid. On the diaphragmatic pleura, at the central tendon, is a single hempseed-sized, flat, firm nodule. The visceral pleura is unchanged. With the exception of a slight amount of edema in the lower lobe, the parenchyma of the lung is normal. The left pleural cavity contains about 1500 c.c. of a fluid similar to that in the right. The diaphragmatic pleura, especially behind the central tendon, contains firm white nodules varying in size from a hempseed to that of a pea. They are located in the thick, injected, and diffusely infiltrated serosa. On the corresponding part of the lower surface of the lung, or the middle of the diaphragmatic surface of the lower lobe, are fo ree pea-sized spots, which are firm, whitish-gray, between 1 and 2 mm. in thickness, ghtly prominent, and surrounded by a markedly injected network of vessels. The onchial glands are normal. The greater part of the left innominate, the left common gular as far up as the level of the thyroid cartilage, the subclavian and the axillary veins, e filled with firm, white, malignant thrombi, from the ends of which extend fresh red rombi for some distance out into the vein. The thrombus in the innominate vein tends only as far as the end of the malignant mass. The peritoneal cavity contains a er of serous fluid. The omentum is retracted toward the transverse colon, yet it still aches the symphysis. The larger omentum is free from tumors, but contains a few radiat-g spots which form centers of retraction. On the parietal peritoneum are a few flat, ayish nodules, varying in size from a millet-seed to a hempseed, most numerous in the ue pelvis, especially in the pouch of Douglas, where also occur deposits of fibrin.

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* Anat. Pathol., Livr. 27, Pl. 2, p. 2.

† Sectionsbericht, Prag. Vierteljahresschr., 1845–47.

‡ Onkologie, p.

§ Du cancer et de sa curabilité, Paris, 1860, p. 59, Pl. 3, Fig. 1.

‖ Brinton (*loc. cit.*, p. 251) states that he has observed cancer of the thoracic duct only once in carcinoma of the stomach.

On the intestine and the mesentery occur a few miliary nodules. The liver extends cm. below the costal arch, and its left lobe extends into the cardiac fossa, because it is rced forward by a nodular tumor lying behind and below it. This tumor is 9 cm. in idth, 7 cm. high, and is flattened where it is in contact with the liver. It is located in the loric end of the stomach, and is pushed forward by the mesentery, which is 3 to 4 n. in thickness. The mesocolon is covered with large, flat, rosette-shaped, cancerous owths. The descending colon is slightly narrowed, because of the extreme retraction the mesentery at this point. The stomach is full, 24 cm. in length, and 8½ cm. in idth. Near the lesser curvature is an injected, whitish network of lymph-vessels on the rous surface, extending partly along and partly between the vessels. The pyloric end is ansformed into a nodular tumor, the individual nodes of which are located partly on the omach and partly on the neighboring portions of the greater and lesser omentum. In e hilum of the liver occurs a mass of partly adherent nodules. When the stomach is lit open, the pyloric end is found to be narrower than normal, yet its lumen readily lmits one finger. At this place occurs a flat, rosette-shaped tumor, 7 cm. in diameter, tuated on the anterior and lower wall, reaching partly around the pylorus, leaving a ace 2 cm. in width at the lesser curvature free from infiltration. The tumor is flat, ther soft, whitish-gray, and has an ulcerated surface. A large amount of whitish-gray ice exudes from the cut surface. The muscularis is 3 to 4 mm. in thickness and is pene-ated by white trabeculæ.

The tumor above the muscular coat measures 4 to 5 mm. in thickness; its edges are ot markedly infiltrated, and its cut surface is uniformly yellowish-gray in color. The ul-r is rosette-shaped. Surrounding it in the mucosa are several movable nodules, varying size from a hempseed to that of a pea. There are also portions of the mucosa 1 cm. in iameter, which are whitish-gray, thickened, and infiltrated, yet they are movable on the uscularis below. These changes are present in a border 3 to 4 cm. in width, which partly rrounds the tumor, the continuity being broken to the right as well as to the left, and it curs as two separate parts, one portion lying on the anterior surface of the stomach and ne on the posterior. They correspond to the places on the stomach where the lymph-essels in the serosa are infiltrated by the white masses. The mucosa of the fundus is ft; it is injected toward the pylorus, slightly grayish, and non-transparent, but not dis-inctly thickened. The stomach contains 500 c.c. of a dark-gray, turbid fluid, mixed ith portions of the food. The stomach holds 2000 c.c. The ulcerated tumor in the yloric end reaches to within 3 cm. of the pyloric sphincter, but the portion of the organ ying between the tumor and the pylorus contains a few scattered spots of malignant in-iltration. The sphincter and the adjoining 1½ cm. of the duodenum are thick, infil-rated, and whitish-gray in color. The mucosa forms a thick, soft, whitish-gray mass, 3 to 5 mm. in thickness. It is movable on the muscularis, which is also hypertrophied so that it measures 2 mm. in thickness. It does not contain any white trabeculæ, but in cross-section it is edematous and penetrated by grayish-white, branched trabeculæ, which are the lymph-vessels occluded by malignant cells. In the liver are numerous soft, whitish-gray nodules, varying in size from a pea to that of a walnut. They have an umbilicated center, and a yellow-gray, cut surface from which large yellowish plugs may be expressed. Furthermore, a cut section of the liver reveals numerous miliary nodules, often collected into groups, and a cancerous infiltration along the larger branches of the portal vein and the hepatic artery. The lower part of the posterior portion of the gall-bladder, the ductus choledochus and the ductus cysticus, are infiltrated with malignant cells to such an extent as to make the passage of the bile impossible, since the wall is stiff, whitish-gray, and 2 to 4 mm. in thickness.

The mesenteric glands are enlarged to about the size of walnuts. All the retroperitoneal glands are markedly infiltrated. The glands along the external and internal iliac arteries are infiltrated all the way down into the groins. The left psoas contains numerous nodules, varying in size from that of a millet-seed to that of a pea. These are scattered throughout the muscular substance and in the surrounding connective tissue. In the capsule of the kidneys are found similar nodules. The hilum of each kidney contains diffuse cancerous masses, and in the parenchyma of the kidney occur scattered nodules as large as peas. The brain is unchanged.

The thoracic duct is dilated throughout its entire course, and filled with a reddish-gray, purulent mass, which consists of granular detritus, fat-droplets, and round or angular cells of varying size, many of which contain nuclei 8 micra in diameter. The location of the valves can be determined distinctly by nodules occurring at these points. At its lower end, where the thoracic duct goes over into the cisterna chyli, its diameter is 0.5 to 1 cm., and it is surrounded by a mass of cancerous lymph-glands. Here is found, on the inside of the duct, a tumor mass which has grown through the wall. Small, soft tumor masses also occur on the neighboring valves. Further up, at the arch of the aorta, the duct is also surrounded by a mass of infiltrated lymph-glands which is 10 cm. in length and 2 cm. in width. The duct becomes more nodular, and is more dilated as it reaches the point where it empties into the left subclavian vein and where the dilated right lymphatic trunk empties into it. This comes through a group of malignant lymph-glands as large as a walnut, and lie between the left subclavian vein, which is dilated and has nodular walls, and the left common jugular.

Cross-section of all these vessels at this point reveals the following: The thoracic duct is filled with the purulent mass already described. On its wall are a few white cancerous tumors varying in size from a pinhead to that of a hempseed. Some of them appear as polypi in the lumen. A group of larger nodules occurs at the point where the duct empties into the vein, being fused with the malignant growth of the vein. The center of this tumor mass in the innominate vein and in the subclavian is made up of a partly discolored thrombus running parallel to the vessel lumen. This indicates that the blood had circulated for a while through the center of the mass. The walls of the veins are firmly adherent to the tumor, but they are not infiltrated with malignant cells. Consequently, it appears as if the malignant cells from the smaller tumors in the thoracic duct grew into the subclavian vein and into the innominate and then spread, first along the walls, and later on occluding the vessels entirely.

Microscopic Examination.—The mucosa of the edge of the ulcer is somewhat thickened, but not villous. The glands in the deeper portion of the mucosa are dilated and irregular, and at certain places they are in direct continuation with bunches of tumor-cells in the muscularis mucosæ. The tumor in the submucosa consists of a connective-tissue stroma rich in small round-cells, in which are found groups of alveoli varying greatly in size, and filled with large round or angular granular cells, from 24 to 30 micra in diameter, and having oval nuclei 9 micra across. The muscularis contains groups of similar cells, both in the interstitial connective tissue and in the muscular bundles themselves.

The tumors in the thoracic duct have a thin granular stroma holding alveoli filled with cells similar to those in the stomach. The tumors in the vein consist of a network of cancerous tissue having large meshes, supported by the intima, but the malignant cells do not enter the vessel-walls. In the center of the lumen is a thrombus of the usual structure. The tumors in the liver consist of a network of medullary carcinoma having large meshes, the alveoli of which are arranged in groups. Their stroma is scant and granular. The liver-cells surrounding the tumors are atrophied, on account of compression by the malignant cells. The portal vein is free from malignant thrombi, but everywhere around its larger branches occur numerous nodules, varying in size from a pinhead to a pea, which lie against the vessel-wall and can be seen through the walls as white, often somewhat elevated, spots. These become smaller and lose themselves among the smaller branches of the portal.

In cross-section of the small veins (which to the naked eye were free from malignant cells), the walls are seen to be infiltrated with cancerous cells. The membrana propria of the bile-capillaries is distinct and lined with regular epithelium. There is a slight dilatation of the capillaries in a few places, but I failed to find any irregular growth of the epithelium. There are no metastatic growths along the hepatic vein. The tumors of the lymph-glands, in the muscles, and in the kidneys are of similar structure. The inferior vena cava is surrounded by the infiltrated retroperitoneal lymph-glands which lie close to its wall, and at one place, between the renal veins, is a flat tumor, 1½ cm. in width, which has broken through the wall of the vena cava. The tumors are covered with intima, and are similar in structure to the others. The wall of the vein is infiltrated with cancerous cells. The lymph-vessels on the serous surface of the stomach and those described in the duodenum both contain epithelial cells, similar in form to those in the tumor of the stomach, and small round lymphocytes without nuclei. These masses of cells are easily expressed from the lumen of the vessels, the walls of which are smooth and apparently unchanged. The epithelium of the intima was not made visible, either by silver nitrate or by chlorid of gold.

There is no doubt that the thoracic duct in this case was the site of a cancerous growth which played some rôle in the spreading of the malignant growths to the veins near its mouth. On the other hand, it seems as if carcinoma in this situation extends in a fashion different from that in the veins, where a continuous mass of carcinomatous cells is everywhere in organic connection with the vessel-walls, even if this is not infiltrated by the malignant cells. In the thoracic duct, on the other hand, there was not found, either here or in the case previous to it, so continuous a mass, but a liquid, purulent substance without stroma. In this substance were malignant cells with large nuclei, which was not strange in my case, because soft cancerous tumors penetrated the lumen, a condition which has not been mentioned by other writers.

The vessel-wall was infiltrated with malignant cells in many places; these originated from the small tumors on the inside. This infiltration of the wall is, in this case at least, the most noteworthy thing seen in extension of cancers through the thoracic duct, for the following reasons:

When the duct contains malignant cells, these are carried by the lymph-stream into the venous blood in the subclavian vein, and from this through the heart into the lungs, and these organs will then be the first places where metastatic growths occur, because there is no likelihood of metastatic growths appearing either in the left lymphatic trunk, the surrounding lymph-glands, or in the large veins at the place where the duct empties. There is very little chance for the cancerous cells to grow into the walls of the veins at this point, since on leaving the lymph-which had produced icterus. On the liver surface were white, flat nodules of various sizes. He does not state what relation there existed between the cancer masses and the connective tissue along the portal vein and that of the liver. These two cases show that observers early noted that cancer could extend through the connective tissue along the veins of the liver.

Like the other cases, mine showed cancerous infiltration of the gastrohepatic and the hepaticoduodenal ligaments and of the gall-bladder, the hepatic as well as the cystic ducts, both of which were occluded. The cancerous tissue which extended along the capsule of Glisson into the liver could be distinguished with the naked eye along the larger branches of the portal vein. When this was slit open, a peculiar picture presented itself, which I had never seen or read about, viz., numerous small, from a hempseed to a pea in size, flat, round, or irregular spots, in the inside of the veins. These were of whitish-gray color, slightly prominent, and covered by the vessel-wall. They were due to the tumors external to the veins shining through their walls, the walls themselves being free from malignant cells.

This infiltration of the connective tissue about the vessels, partly of fully developed cancerous tissue and partly of simple inflammatory tissue, extended as far as to the individual acini, or as far as the capsule of Glisson might be said to reach. It was, therefore, a sort of an interstitial carcinomatous hepatitis. At a few places in this mass individual tumors appeared, but the infiltration around the smallest veins could not be distinguished with the naked eye, and the liver tissue appeared to be normal macroscopically at these points. It does not seem as if cancerous involvement of the liver along this route could be very rare. In a few isolated cases the bile-passages are supposed to play a rôle in the development of cancer in the capsule of Glisson. Naunyn* noted that the epithelium of the bile-tract grew out as plugs or buds similar to those formed in carcinoma of the stomach. He observed this mode of extension most frequently in cases of primary cancer of the liver, but he also found it in a few cases of secondary involvement of the organ. Yet he believes that secondary cancer, as a rule, springs from malignant emboli.

I have never been able to observe that the epithelium of the bile-passages takes any active part in the development of cancer. In the last-mentioned case, where one might expect that the epithelium had undergone some changes because of the close association of the passages with the cancer in the connective tissue outside of them, I did find a few of the ducts dilated, but this was due to the retention of bile and there was absolutely no irregular proliferation of the epithelial cells.

(*B*) *Cancer in the Connective Tissue Around the Large Vessels Running Along the Spinal Column.*—Cancer may extend slowly and often discontinuously in the loose connective tissue along the aorta, the inferior vena cava, and even along the branches of these, in the same manner as it does in the connective tissue of the liver, as is shown by the last case, for in this instance cancerous infiltration was present around the vessels in the hilum of both kidneys. The small multiple tumors in the kidney tissue, in the capsule of these organs, and in the psoas muscle, probably also originated by direct extension through the loose connective tissue, for these growths cannot be explained by assuming them to be metastatic deposits from the greater circulation, since no other muscles or connective tissue in any other part of the body were involved. If the malignant cells, when extending in the connective tissue, always formed a directly continuous growth, this mode of extension could readily be explained. But this is not always the case. In this instance there were, as mentioned, multiple tumors in the capsule of the kidneys and in the vessels. There is no anatomic explanation for this condition. It appears as if extension of the malignant cells might occur in one or the other of two purely hypothetic ways: In the first place, it is possible that the lymph-vessels might be the channels along which the malignant cells travel, and the question of cancer-cells traveling against the lymph-stream comes up at this point, since in this case the lymph naturally passed from the kidneys toward the glands around the aorta, and from the psoas muscle to the lymph-glands around the iliac vessels. Of course, one could overcome this difficulty by assuming that the lymph-current was reversed because the central glands were clogged up. For instance, if the lymph-glands along the aorta were obstructed, the lymph-stream might flow toward the inguinal glands, or if the iliac glands were clogged, the lymph-current might pass through the psoas muscle. If the valves in the lymph-vessels would permit such a change in the lymph-current, it is conceivable that the malignant cells might extend in this fashion and thus form the metastatic growths like those in question.

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* "Ueber die Entwickelung der Leberkrebse," Arch. f. Anat. u. Physiol., 1866.

In the second place, extension of the cancer through the connective tissue might take place without the aid of the lymph-vessels by the malignant cells forcing their own way through the loose connective tissue, in the same way as the white blood-corpuscles. Ameboid movements of cancer-cells have been observed very recently by Waldeyer,* who noted that epithelial cells from a recently extirpated carcinoma of the mammary glands slowly changed their shapes for a considerable time after the extirpation. He examined the cells in a drop of the patient's *blood*, which was kept at body temperature. As stated, these attempts at explaining the extension of cancer in the connective tissue are purely hypothetic in nature. All we know at present, then, is that the malignant cells do extend in the loose connective tissue, and that their ad- ance is neither by direct growth nor through extension by blood or mph-vessels. Further investigations must be undertaken in order to ake the method of extension in this tissue plain.

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* Virchow's Archiv, 1872, vol. lv, p. 83.

CANCEROUS INVOLVEMENT OF NERVES

The lancinating pains so characteristic of cancer suggest involvement of the nerves. That pain is often absent or very mild, both in cancer of the stomach and in malignant growths of other organs, is well known. This might be due to the local relations between the tumor and the nerve. But there do occur a number of cases of cancer in the mammary glands and the stomach in which pain is very pronounced, and cannot be controlled by narcotics. The pain appears without any external provocation, has no relation to meals or other things, and presents remissions and exacerbations similar to the pain of nervous origin, when it is customary to assume that it is due to lesions in some part of the nerve-stems, as, for instance, in the trigeminus in case of neuralgia, the nerve being thought to be involved in the parts passing through the various foramina. Lesions in the nerve-stems have been found in cases of cancer accompanied by violent pain, such lesions being frequent in cancer of the mammary glands in which neuromata have been observed both on the mammary and on the intercostal nerves. So far as cancer of the stomach goes, little has been done to investigate the source of the pain. The large nerve-stems forming the end-branches of the vagi, which have a diameter of 1 mm. and are distributed about the cardia and the lesser curvature, might in many cases of cancer of the stomach come in direct contact with tumor masses on the peritoneal surface or in the external layers. The relation between tumor nodules and nerve-bundles in contact with them is said to vary. Förster[*] never, and Walshe[†] very seldom, observed malignant cells infiltrating a nerve-stem. Rokitansky[‡] states that cancer in the nerve-stems in the great majority of cases is secondary, and that it is remarkable how little resistance the nerves offer against malignant invasion. Cornil[§] reviews the literature, which is very scant concerning this particular subject, and has himself observed four cases of cancer secondary in various peripheral nerves. He also gives a good description of the relation of cancer-cells to nerves. It is, after all, not very rare for cancer to extend in the stems of the peripheral nerves, and in case of carcinoma of the stomach the anatomic relations often give opportunity for such extension. For this reason it is strange that such an involvement should have been observed so little, and that the literature on cancer of the stomach should be so singularly free from observations along this line. And it is still more strange that the few cases recorded were observed at a time when microscopic investigation was no carried out. I now wish to state briefly my own observations on thi point.

Prus[||] states that Cruveilhier once found scirrhus in the right vagu Cruveilhier, however, did not seem to have placed any special emphasi on this, since it is not mentioned in any of his larger pathologic works. Prus himself observed cancerous infiltration of the right vagus in an instance of carcinoma of the lesser curvature in a man fifty-two years old, which gave the usual symptoms, among which was a moderate amount of gastralgia, which could be controlled readily by opium. By tracing the right esophageal plexus toward the stomach, he found that the nerve-fibers in the cardia which led to the tumor on the lesser curvature were there as thick as their normal diameter for a distance of 1 cm. They were of the usual color and consistence, but they were lost in the tumor mass and could not be traced to the infiltrated layers of the stomach. Prus considered this lesion of the nerve-fibers to be of a scirrhous type, and believed that the lesions on the nerves were the cause of carcinoma of the stomach. He considered this case a weighty proof for the idea that the nervous system formed an important factor in the etiology of cancer.

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[*] *Loc. cit.*, p. 435.

[†] Nature and Treatment of Cancer, p. 53

[‡] Handbuch, 1856, vol. ii, p. 501.

[§] "Sur la production des tumeurs epitheliales dans les nerfs," Jour. de l'anat. et d physiol. par Robin, 1864, p. 183.

[||] *Loc. cit.*, p. 56, 1829.

A few years after this Lombard* reported a few cases belonging to this type. Among the cases from the military hospital at Genoa occurs one case of cancer of the pylorus which was accompanied by cancerous infiltration of both vagi. A carpenter sixty-five years old entered the hospital markedly emaciated. He was very constipated, often vomited dark masses, and died four weeks after entrance to the hospital. Whether or not pain was present is not stated, but at any rate it could not have been pronounced, since the other symptoms were accurately described. Postmortem examination showed ulcerated scirrhous carcinoma of the pyloric end and some hypertrophy of the muscularis. Both vagi, from the angle of the mandible down to the stomach, were twice their normal thickness. They were firm and irregular, but without nodules or discolored portions. This thickening could be traced into the small branches running to the esophagus and the musculature of the stomach. Some of the branches going to malignant glands in the lesser curvature were not thickened. The thoracic aorta was diffusely dilated and atheromatous. Otherwise the organs of the body were unchanged. Lombard does not state of what nature the lesions in the nerves might have been, nor does he correlate them with cancer of the stomach. On the other hand, he believes that the hypertrophy of the musculature of the stomach was due to the thickening of the vagi, and uses this occurrence as a proof for the idea that the vagus is a motor nerve for the stomach.

The second case was that of a man, forty-three years of age (the clinical history is not given), in whom was found carcinoma of the pylorus associated with thickening of the thoracic part of the right vagus. The left vagus was unchanged. The branches of the right which enter the lesser curvature and those going to the pylorus were markedly thickened, some of them being thicker than the main stem. Lombard held that the lesions in the vagus had produced a partial hypertrophy of the muscularis in the cancerous portion of the pyloric end. This supposition he considered further supported by a case in which the stomach, as well as both vagi, was atrophied.

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* Gaz. méd. de Paris, 1836.

None of the writers mentioned present the idea that the lesions in the nerves might have been secondary to carcinoma of the stomach, although they probably suspected the lesions of the nerves to be of a cancerous nature. Nor did it occur to them that the condition of the nerves might have had some relation to the gastralgia. Whether in reality the nerves were the seat of malignant growths or of a benign proliferation of the interstitial nervous tissue is impossible to say, since microscopic investigation was not made. In Prus' case, where the smaller portion of the nerves was involved, it does look as if the thickening were due to infiltrating carcinomatous cells, which grew into the nerve from the primary tumor in the stomach, since such an occurrence is not rare. But the diffuse infiltration present in Lombard's case, in which almost the entire vagus was involved, could scarcely have been due to malignancy, since similar cases of a cancerous nature have never been seen.

Only very few of the later writers have directed their attention to the relation of the nerves to carcinoma of the stomach. Watson* cites a case of carcinoma of the lesser curvature in a man of thirty-six who for eight months had suffered from severe pains in the epigastrium. Here the branches of the vagus could be seen to enter the firm scirrhous tumor mass and become lost in it. This condition, he thinks, explained the severe pains. Habersohn† does not give any specific cases, but remarks that sometimes the vagus might penetrate the tumors in the stomach, and in such cases the fibers are either of normal appearance or entirely destroyed. This destruction of the nerve-fibers may in individual cases produce cessation of the pain and gastric irritability toward the end of the disease. The two writers just mentioned did observe, then, that the nerves entered the tumor, and interpreted the pains as being due to this. Habersohn puts particular emphasis on the fact that destruction of the nerves leads to disappearance of the pains. Neither of them, however, observed the extension of malignant cells along the nerve-stems.

Since I have observed a few cases of this kind I wish to call attention to the relation between cancer of the stomach and the nerves. According to my experience, cancer of the stomach frequently involves the branches of the vagi in the stomach, as I observed 4 instances in 29 cases. The condition in the nerves may be as follows:

Either spindle-shaped neuromata are found at certain parts of the stem at a lesser or greater distance from the original tumor, which are structurally very similar to those which Cornil has described on the branches of the axillary plexus or on the intercostal nerves in cases of carcinoma of the mammary glands, or the nerve-stem, prior to its entrance into the malignant tumors, forms a cone-shaped tumor, 1 to 2 cm in length and 4 to 5 mm. in width, the base being next to the tumor The tumor might be either the primary one in the stomach-wall or masse of malignant lymph-glands, situated either in the lesser curvature o more frequently on the posterior surface of the stomach; in such cases the right stem of the vagus is involved.

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* von Henoch: Klinik der Unterleibs-Krankheiten, 1863, p. 304.

† Diseases of the Abdomen, London, 1862, p. 168.

These neuromata or swollen parts of the nerves consisted of carcinomatous tissue in all my cases, and they were due to secondary infiltration of the nerves. According to the consistence of the primary tumors, they are more or less firm, containing scant amounts of cancer juice, or they are softer and their cut surface exudes an abundance of purulent fluid. As far as the structure goes, the nerve-bundles are separated from the carcinomatous tissue in the older portions of the neuroma. Cornil* found carcinomatous cells in the neurilemma and in the perineurium. This infiltration had separated the smallest nerve-bundles. In a great majority of cases he found both the alveoli and the individual cells to be strikingly small. I observed the same in two of my cases, but in the others the size of the cells was that of their fellows in the original tumor.

While Cornil found the malignant cells limited to the neurilemma, so that the smallest nerve-bundles were intact, I observed the tumor-cells penetrating between the individual nerve-fibers which were in immediate contact with the cells. In a longitudinal section of one of these neuromata, in Case XXX, the nerve-fibers were seen to be separated by long, narrow columns of cells which were often but two cells wide. As far as I could determine with an oil-immersion lens, these cells lay against the naked nerve-fibers.

Fig. 5 of Plate I shows a cross-section of one of these neuromata. At 1 the inner neurilemma can be seen between the smallest nerve-bundles; at 2 are groups of malignant cells; and at 4 are small, irregular groups of nerve-fibers cut across, between which are cancerous cells.

Only in one case (Case XXXII) were there any signs of neuritis in the form of inflammatory tissue with long columns of small round-cells between the nerve-fibers.

The individual nerve-fibers are, as a rule, to a greater or lesser extent involved, but, as Cornil states, only partially so; thus some nerve-fibers or groups of these might be finely granular, with elongated groups of fatty granules within them—the same fatty degeneration which is observed when nerve-fibers are sectioned or in cerebral paralyses. Other nerve-fibers are entirely unchanged, and, what is remarkable, indeed, is the fact that what are apparently entirely normal nerve-fibers may be completely surrounded by tumor-cells. Granular degeneration of some of the nerve-fibers of the vagus may extend beyond the parts infiltrated by cancerous cells. In such parts of the nerve as lie outside of the neuromata there occurs, besides the granular degeneration, an atrophy of the nervous tissue, so that the nerve-stem looks like a finely striped connective tissue. Such spots were found in my first case, and in a case belonging to Heller, which is to be described later. These are the same degenerative changes seen, for instance, when nerve-fibers are cut across. In such cases the fibers first undergo fatty degeneration are filled with columnar cells, while the majority are lined with normal epithelium. The muscularis mucosæ is greatly thickened, and between the muscular bundles is a granular connective tissue rich in oval or round, sharply outlined nuclei, which are 6 to 9 micra in diameter. These are not similar to the nuclei of the small round-cells found in ordinary inflammation, but suggest rather the nuclei of malignant cells, which are free from cytoplasm. There are no alveoli present. Underneath the mucosa is a firm, white, fibrous mass, 2 mm. in thickness, and a similar mass is found outside of the muscularis, which has sloughed away. This consists of a fibrillar connective tissue which is markedly wavy. Certain parts of this tissue are finely granular, and contain short elastic fibers and scattered large round-cells having a granular cytoplasm, and measuring about 12 micra in diameter. These are arranged in small groups, but an alveolar arrangement cannot be seen. In the

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* *Loc. cit.*, p. 193.

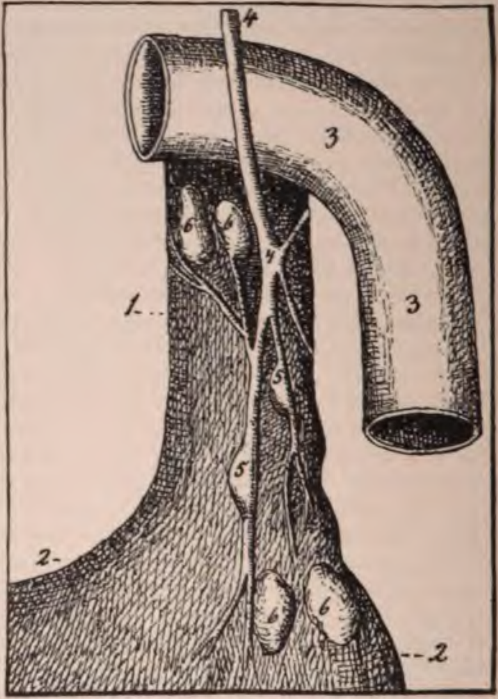

Fig. 11.—Esophagus and cardiac end of stomach, seen from the front: 1, Esophagus; 2, 2, stomach; 3, 3, aorta; 4, 4, vagus; 5, 5, spindle-shaped neuromata of branches of vagus; 6, 6, 6, 6, small cancerous lymph-nodes about the esophagus.

edge of the ulcer the muscularis measures 6 to 7 mm. in thickness. It has been bent inward toward the mucosa. The muscularis is penetrated by white septa, similar in structure to the white mass in the submucosa. These septa are also free from alveoli. The thickened lower part of the esophagus is seen to be the part most recently invaded by the cancerous cells, because groups of epithelial cells, 15 to 20 micra in diameter, with round nuclei measuring 6 micra across, occur everywhere between the muscular bundles. These cells are not limited to the connective tissue between the bundles, but are seen to force their way between the individual muscle-fibers. In some of the muscle-fibers there can be seen columns of fat-globules.

In cross-section the muscular fibers are forced apart by groups of carcinomatous cells. The neuromata on the vagi are produced by carcinomatous infiltration. In places where the malignant tissue has reached its greatest development there are found small alveoli, 35 to 45 micra in length, filled with cells, measuring 12 micra, and containing large round nuclei (6 micra). In places where the cancerous infiltration is more recent, a longitudinal section shows spindle-shaped groups of malignant cells which extend between both the bundles of nerve-fibers and the individual fibers. In cross-section groups of carcinomatous cells can be seen partly in the neurilemma and partly between the smaller nerve-bundles as groups of cells separating the nerve-fibers into bundles varying in size, a picture very similar to that seen in cross-section of muscles which show carcinomatous infiltration.

The connective-tissue sheath covering the entire nerve is not involved to any greater extent than is the rest of the nerve. In the oldest portions of the neuromata the cancerous cells show granular degeneration and contain fat-droplets, but neither connective-tissue stroma nor alveoli are present. The nerve-stems above and below the neuromata contain fibers in which the myelin sheath is undergoing granular degeneration, as well as portions where the fibers seem to have been replaced by connective tissue. The lymph-glands along the aorta contain carcinomatous cells, 15 to 21 micra in diameter, having round nuclei. These are scattered in the lymphoid tissue without attempts to form alveoli. The small nodules on the peritoneum consist of inflammatory tissue and malignant tissue containing alveoli, lined with cells similar to those in the other tumors. The enlarged follicles in the intestines are free from malignant cells.

There is no doubt that the intense neuralgic pains present in this case were due to the neuromata present on the vagi. That these were secondary to the malignant ulcer of the stomach, and not an incidental complication, is plain from their size and structure, for if the tumors were primary in the nerves, they would have been larger. Then, too, it is very doubtful if carcinoma ever occurs primarily in the nerves. The more recent ideas about development of carcinoma speak strongly against this. Furthermore, the early symptoms, such as nausea and vomiting, suggest a primary involvement of the stomach. Of course, one might conceive of lesions in the nerves producing such symptoms, but clinical experience speaks against this, and in Heller's case, where the vagus was infiltrated by malignant cells higher up, there were no stomach symptoms. Heller found the bronchial glands, the bronchi, and the pleuræ infiltrated by carcinomatous tissue, and the right vagus was involved in the region of the bifurcation of the trachea for a distance of 6 cm. The cancer had extended from one of the bronchial glands, and reached some distance up into the recurrent laryngeal. The patient had suffered from pain in the back for half a year, to which was added paralysis of the right glottis with dyspnea. But the patient was absolutely free from symptoms suggesting disturbances in the innervation of the stomach. At any rate, none of such a nature are recorded.

I failed both in this and the following cases to find signs of hypertrophy of the muscularis of the stomach, which, according to Lombard, is produced by neuromata on the vagi.

It is rather remarkable that in this case the carcinoma of the nerves appeared as spindle-shaped neuromata along the nerve-stems. One of these was without direct connection either with the cancer in the stomach or in the lymph-glands. Just in what way the cancer is transplanted in such cases is difficult to prove, but it is analogous to carcinoma of the mammary glands.

In the larger percentage of cases I found the malignant cells extending some distance into the nerve-stems which enter the malignant tumors. In such instances cone-shaped tumors occur, the bases of which are in direct continuation with the original tumor. Case XXVI was the first instance of this type, to which I again refer at this point.

In this case both the posterior vagus and a large branch of the anterior were infiltrated by malignant cells for 1 to 2 cm. The cells of these tumors were not appreciably smaller than the cells of the primary tumor, which shows that the malignant cells in the nerves are not constantly smaller than those of the primary tumor, as is held by Cornil. The pains in this case were always pronounced, and at times so intense that they could not be controlled by narcotics. Hence it seems reasonable to suppose that the pain is caused by involvement of the nerves. The last month before death the pain gradually decreased, and near the end it was entirely absent for days. It is possible that Habersohn is right when he claims that the cessation of pain in the last stage is due to destruction of the irritated nerve-fibers coming from the stomach. But why the irritated main stem of the nerve should not lead to as much pain in the later stages as in the first is hard to say.

In the following case only the right vagus was infiltrated by carcinomatous tissue:

Case XXXI.—*Mixed form of carcinoma and cylinder-cancroid. Firm, scirrhous, ulcerated tumor on the lesser curvature. Erosion of the right superior coronary artery, with fatal hemorrhage. Carcinomatous infiltration of the lymph-glands around the stomach, along the aorta, and in the left supraclavicular region. Lymph-vessels on the external surface of the stomach filled with malignant cells. Carcinomatous infiltration of the lower part of posterior vagus. Pain not pronounced.*

Marie Nielsen, age forty-five, married, entered the hospital December 1, 1871, with the signs and symptoms of acute catarrh of the stomach, viz., gastralgia, nausea, vomiting, and some fever. These symptoms had been present for four days. She was well nourished and strong, but rather anemic. After two weeks she left the hospital well, but only four days later the attacks recurred; this time they were associated with diarrhea and tarry feces. She reëntered the hospital January 13, 1872. Palpation now revealed a tender, pulsating tumor over the cardia, and later a smooth, firm tumor (the left lobe of the liver pushed forward) could be felt at this point. During the following month and a half she suffered occasionally from severe gastralgia, had tarry stools, and often vomited a coffee-ground material. She lost flesh and strength rapidly. Six hours before death she vomited a mucous mass mixed with fresh blood. This was followed by a profuse hemorrhage, at the end of which she died. The disease had lasted three months.

Autopsy, twenty-four hours after death. The body is highly emaciated. Rigor mortis present. Numerous striæ gravidarum are present, and through the relaxed abdominal wall an undulating fluid can be felt in the peritoneal cavity. In the left supraclavicular region is a distinct swelling, which is made up of firm, enlarged lymph-glands. The heart is small and soft and normal in form. The peritoneal cavity contains three liters of a clear, serous fluid. The stomach is slightly dilated. The lesser curvature is everywhere adherent to the posterior surface of the left lobe of the liver, and on the corresponding part of the serous surface of the stomach occur a white network of injected lymph-vessels and also a few firm nodular growths. Along the anterior part of the greater curvature, between it and the colon, there are firm, white, enlarged lymph-glands, and on the neighboring part of the stomach the vessels are again injected, and contain a rather firm mass, made up of round- or polymorphous epithelial cells with large nuclei. The pyloric end is firmly adherent to the liver near the suspensory ligament, and it appears as a firm nodule, as large as a hen's egg, which is covered by the liver.

The stomach is filled with a coffee-ground-like substance in which occurs a dark coagulum the size of a fist. The duodenum contains a similar fluid, which is a trifle redder in color than that in the stomach. The lining of the stomach is covered with a thick layer of bloody mucus. Along the entire length of the lesser curvature, from 1 cm. to the right of the cardia to 1 cm. to the left of the pyloric sphincter, there is a malignant ulcer, 7 cm. in length, which extends symmetrically down over both the anterior and the posterior surface, 7 to 9 cm. respectively. The ulcer is flat. From in front its bottom is made up of the left lobe of the liver, the parenchyma of which is discolored, covered with dark spots, and eroded so that the surface appears ragged. The parenchyma of the entire left lobe is rather soft, but free from cancerous growth. Behind, the bottom of the ulcer is formed by the pancreas, and on its surface occurs a white, rather firm, irregular mass of connective tissue. In the lesser curvature the mucosa and the muscularis have sloughed away, and the bottom of the ulcer is very irregular, studded with shreds of tissue and lumps of necrotic material. Through one of these necrotic masses, which is situated at the pylorus, a stream of water exudes when water is injected into the aorta. This comes through the right superior coronary artery, which is eroded at this point. There are scattered enlarged lymph-glands along the esophagus and aorta. These glands often lie in direct touch with branches of the veins.

At the cardia there is found, on the right vagus, a firm white mass which is cone-shaped and 1 cm. in length. This tumor is semisolid, has a smooth, whitish-gray, cut surface, from which a milky fluid can be expressed. This consists of epithelial cells and débris. In the musculature of the esophagus there are a few scattered firm nodules as large as hempseeds. There is a mass of enlarged lymph-glands in the left supraclavicular region. The mucosa of the upper part of the duodenum is finely pigmented. The lymph-glands in the hilum of the liver and the retroperitoneal lymph-glands form firm nodular conglomerates of tumors, a few of which are large as nuts. The parenchyma of the liver is free from growths. The spleen is enlarged; its pulp is pale, rather soft, but tenacious. The rest of the organs are unchanged.

Microscopic investigation shows the following: The tumor in the stomach is a mixed form, consisting of "cylinder-cancroid and carcinoma." The muscularis of the stomach at the edge of the ulcer appears as a layer scarcely ½ mm. in thickness, where both the muscle-fibers and the malignant cells have undergone a granular degeneration, which does not seem to contain any fat-droplets. External to the muscularis is a firm, white, fibrous layer, 1 cm. in thickness, consisting of connective tissue free from malignant cells. The lymph-glands also have a connective-tissue stroma containing small alveoli filled with round- or polymorphous cells. The enlarged lower part of the vagus is infiltrated with carcinomatous tissue, which had penetrated between the nerve-bundles partly as alveolar carcinoma and partly as long columns of carcinomatous cells which have extended between the individual nerve-fibers. The alveoli, as a rule, are 60 to 90 micra in diameter, and often only 6 to 12 micra. Between these occur broad septa of connective tissue. The individual cells are also smaller than those of the primary tumor. Some of the nerve-bundles are normal in appearance; others are filled with long columns of fat-globules, and the nerve-fibers cannot be distinguished. The nerve-stem above the neuroma consists partly of unchanged nerve-fibers and partly of nerve-bundles which have undergone fatty degeneration and show groups of fat-granules between the fibers.

The structure of the neuroma differed from the tumor in the stomach only in the fact that the alveoli and the cells were smaller than those found in the primary growth. I have never seen columnar cells in the nerve. This case also had a partial granular degeneration of the nerve-bundles above the tumor. In this case the pain was not particularly intense and continuous, and not any different from that in cancer of the stomach in which the nerves are not involved.

The following case is of peculiar interest on account of the entire absence of pain:

Case XXXII.—*Medullary carcinoma; large, semisolid, ulcerated tumor on the posterior wall of the fundus and the left half of the lesser curvature. Malignant lymph-glands behind the stomach. Cancerous infiltration of the lower part of the posterior vagus; granular degeneration of some of the nerve-fibers above the neuroma; absence of pain during the entire disease. Croupous pneumonia of both lungs.*

Karen Christoffersen, age seventy-five, suffered from cough for two months, was emaciated, and had no appetite, but she had never had any gastric symptoms. She entered the hospital complaining of bronchitis. Both the lower lobes were involved. She was emaciated and weak, but showed no signs of gastric involvement. A month after her entrance she contracted a lobar pneumonia of the lower lobe of the right lung, and she died eight days later.

Autopsy, nineteen hours after death. The body is that of an extremely emaciated female, 152 cm. in length. Rigor mortis present; both legs edematous. The heart is small. The right pleural cavity contains 500 c.c. of a cloudy serous fluid, in which occur a few flocculi of fibrin. The upper lobe of the lung is normal, but the lower lobe is to a great extent solid. There is not a particularly large amount of blood in the tissue, but the lobe is filled by a thin, purulent fluid. The cut section is slightly granular, grayish-red in color, and a purulent, slimy fluid can be expressed from it. The pleura covering this part of the lung is roughened, and here and there covered with a fresh, fibrinous exudate. The left pleural sac contains 500 c.c. of a reddish, serous fluid. The lower lobe is somewhat edematous. In the posterior part of the upper lobe there is an area of lobar pneumonia. There is no fluid in the abdominal cavity. The stomach is small, 14 cm. in length, and the pyloric end is as wide as the fundus. The serous layer is unchanged, except on the posterior surface, where it is adherent to the pancreas, forming firm, continuous, nodular masses.

The capacity of the stomach is considerably reduced. It holds 250 c.c., and is empty. On the posterior surface of the lesser curvature is a nodular tumor, 9 by 7 cm. It is very irregular, and has an ulcerated center. The bottom of the ulcer is smooth, and its edges are perpendicular and of a semisolid consistence. The pancreas itself is free from tumor masses, but the connective tissue surrounding it contains a nodular tumor which is adherent to the stomach. Close to the aorta lies a tumor as large as a walnut, through the center of which the splenic vein passes before it reaches the pancreas. The rest of the retroperitoneal glands are free from metastasis. The posterior (right) vagus passes through the tumor close to the aorta. Where the nerve enters the tumor its stem is thickened to form a cone-shaped nodule 1 cm. in length and 5 to 6 mm. in diameter. It is firm and of a grayish-white color; its base is toward the tumor. Its cut surface is smooth, and from it a milky fluid can be scraped. The liver is small; a constricting band runs across the right lobe. It is free from metastatic growths. The other organs are rather anemic, but otherwise unchanged.

Microscopic Examination.—On the edge of the ulcer the mucosa presents prominent villi, and measures 0.6 to 0.8 mm. in thickness. The fundi of the gastric glands are slightly dilated, are very irregular in their course, extending partly into and partly through the muscularis mucosæ, where they end in the tumor of the submucosa. This tumor consists of a markedly granular connective-tissue stroma, in which are found large alveoli containing round- or polymorphous cells, 21 micra in diameter, some of which have oval or round nuclei. But most of the cells have been changed into a granular débris. Between the muscular bundles is found cancerous tissue of the same structure. The malignant masses around the splenic vessels on the posterior surface of the stomach are also of a medullary type, but the stroma is not so well developed at this point, and the alveoli are smaller. In the involved part of the vagus are masses of carcinoma cells between the bundles of nerve-fibers. The malignant cells are of the same type and size as those in the stomach. The neuroma also contains numerous small round-cells. Only the lower part of the neuroma contains distinct small alveoli. A part of the nerve-fibers above the infiltrated part of the vagus have undergone granular degeneration. The rest appear normal. The normal and the diseased fibers are evenly mixed.

The absolute absence of pain in this case is all the more remarkable when one recalls that the infiltration of the cancer-cells into the nerve was accompanied by a round-cell proliferation, a condition which is supposed to signify irritation of the nerves. Since a round-cell infiltration was not present in any of the three cases preceding this, one might believe that since an acute inflammatory process was present here the pains should have been severe. Furthermore, the presence of degenerated nerve-fibers, both in and above the neuroma, renders the absence of pain still more remarkable.

It is impossible at present to explain this condition, and without attempting to give a hypothetic explanation for it, I simply wish to state that both in this case and in the one described just prior to it, in which the pains were slight, it was the right or posterior vagus alone which was involved. But it is absurd to assume a difference as to sensation between the right and the left vagus, hence this does not offer any explanation. The absence of pain, then, must be due to some as yet unknown condition. It is well known that neuromata consisting of purely connective tissue often are free from pain. Rokitansky* states that all the cases of multiple fibroid neuromata he had observed were free from pronounced pain. Heller† had two cases of multiple fibromata on the lower extremities which were not associated with very much pain. As an example of cancerous degeneration of a known sensory nerve, but without spontaneous pains, I wish to cite a case observed by Neumann.‡ This was a case of epithelioma on the lower lip. From the ulcer a thin, firm string, 1½ cm. in length, and tender to touch, extended to the left mental foramen. The patient had never suffered from spontaneous pain. An operation revealed the firm string to be the mental nerve, which was 1 mm. in thickness and rather irregular. Microscopic examination showed the nerve-fibers spread apart by the same type of cells as those found in the malignant growth. The nerve-fibers appeared normal.

The results obtained from the foregoing considerations and cases cited are briefly as follows:

1. Cancer of the stomach may extend into the end branches and the

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* Lehrbuch der pathol. Anat., vol. ii, p. 501.

† Virchow's Archiv, 1868, vol. xliv, p. 338.

‡ *Ibid.*, 1862.

stems of the vagi, and from either separate spindle-shaped swellings or a continuous bulbous thickening of the nerve at its entrance into the tumors.

2. The primary tumor may be scirrhous, medullary, or a mixed form of carcinoma, but the growths in the nerves were either scirrhous or medullary carcinomata. The alveoli and the individual cells are sometimes of the same size as those of the original growth, at other times they are smaller.

3. The malignant cells are found not only in the neurilemma between the larger nerve-bundles, but also between individual fibers.

4. Part of the nerve-fibers undergo granular degeneration, which may extend for some distance above the part involved by the cancerous growth. Other nerve-fibers appear normal.

5. The view held by older pathologists that cancer of the nerves leads either to cancer of the stomach or to hypertrophy of its muscularis does not hold good.

6. The relation between cancer of the nerves and pain is not constant. Cancer of the nerves may be present without pain, and again may be accompanied by excessive pain of a neuralgic type.

7. The cause of the pain is not to be found in the granular degeneration of the nerve-fibers alone, nor in the chronic inflammation associated with the cancer, but must be considered as still unknown.

EXPLANATION OF PLATE I

Fig. 1.—Scirrhus in muscle of esophagus. The malignant cells occur in oblong groups between the muscular fibers: 2, Muscular bundles cut longitudinally with groups of carcinomatous cells at 2; 3, cross-section of smooth muscle-fibers showing malignant cells between them at 4 (Hartnack immersion 10, ocular 2).

Fig. 2.—Mixed tumor originating in the gastric glands (Case VII), the section taken from the edge of the ulcer: 1, Naked papillæ; 2, the upper layer of the mucous membrane, consisting of connective tissue without visible glandular ducts; 3, the base of glands at the pyloric gland; 4, muscularis mucosæ containing irregular cavities filled with round-cells and alveoli lined with epithelial cells. These cavities are connected with the glands at 5 and 5 *c*, which send extensions through the muscularis mucosæ; 6, larger alveoli with columnar cells in the tumor mass; 7, in the submucosa (Hartnack objective 4, ocular 2).

Fig. 3.—Mixed tumor. One alveolus and transitional forms of epithelium. At *a*, columnar cells; at *b*, transitional forms, and at *c*, usual round- and polymorphous cells (Case XVIII) (objective 7, ocular 2).

Fig. 4.—Network of lymph-vessels filled with cancer-cells on the serous surface of the stomach: 1, Arteries and veins, the perivascular spaces between which are filled with malignant cells; 2, network of lymph-vessels filled with carcinoma cells between the blood-vessels (Case XXXI, normal size).

Fig. 5.—Cross-section of neuroma of the vagus: 1, The inner neurilemma; 2, bundles of nerve-fibers cut across; 3, groups of carcinoma cells in the neurilemma; 4, malignant cells between the individual nerve-fibers (Case XXX) (Hartnack immersion 10, ocular 2).

PLATE I

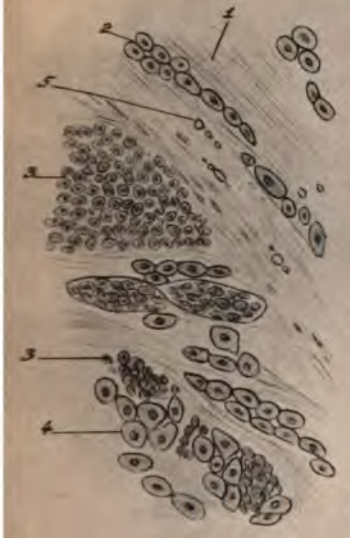

Fig. 1.

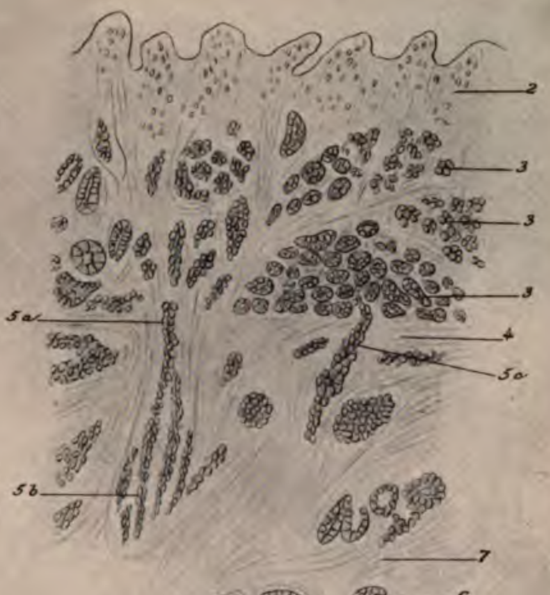

Fig 2.

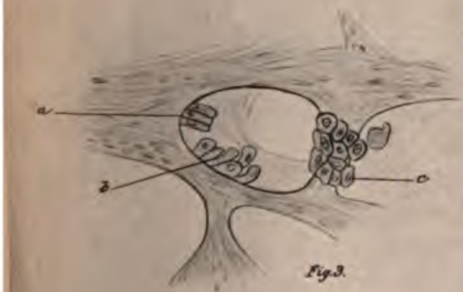

Fig. 3.

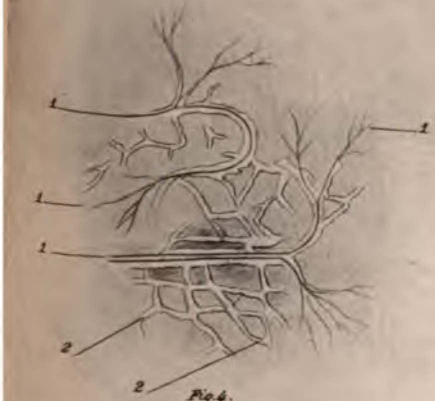

Fig. 4.

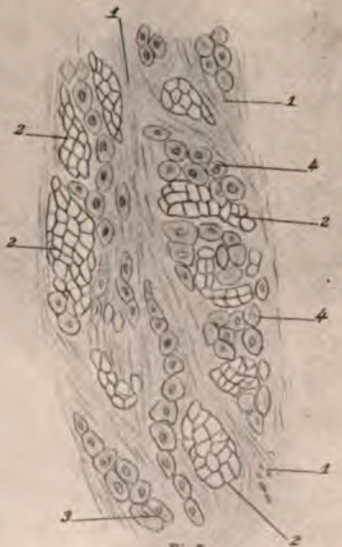

Fig 5.

Explanation in text.

UN MOT SUR L'EPÍZOOTIE CHEVALINE

Au Caire en 1876*

En présence de l'Épizootie qui a sévi sur les chevaux au Caire, dans
lerniers temps, en faisant des ravages tels, qu'en moins de 2 mois, les
x tiers des chevaux ont été emportés par ce mal inconnu, nous avons
lu rechercher la nature d'une maladie et d'une épidémie aussi ef-
antes et sur lesquelles il existait ici des opinions si contradictoires.

Tandis que les uns parlaient de typhus charbonneux, les autres at-
uaient l'origine à des affections diphthéritiques ou à une variante du
ıp, etc., etc.

Ainsi que nous allons le démontrer, en donnant le résultat de nos
ıerches, l'opinion s'égarait.

Pour nous rendre compte de la maladie, nous nous sommes attaché à
uivre dans toutes les phases et à l'étudier, en nous aidant du ther-
nètre, du microscope et autres instruments de la plus grande pré-
on.

Nous avons diverses autopsies qui nous ont donné des résultats qui
cordent; c'est pourquoi nous ne donnons ici que le détail d'une de
autopsies pour servir de type.

Le 23 septembre, à midi, la maladie s'est tout-à-coup déclarée sur
cheval européen, grand, fort, bien fait, jusque là en pleine sante, âgé
12 ans, et qui, la veille, avait, comme d'habitude, fait dans les condi-
ıs normales, une longue promenade.

Les premiers symptômes objectifs ont été: manque d'appétit,
lesse, débilité, congestion aux conjonctives de l'œil et des paupières,
empérature plus élevée (prise à l'anus, 42°), la respiration brève et
adée, les gencives injectées de sang et gonflées, la langue sèche et
ıche.

Nous avons donné par la bouche et par injection sous-cutanée 5
mmes de sulfate de quinine et un gramme et demi d'acide carbolique
olution. Une heure après, la température était descendue à 40°; le
elle était à 39°.

Vers le soir, le cheval continuant à être très faible et inquiet, nous lui
ıs encore donné un gramme et demi d'acide carbolique par injection
-cutanée. Presque immédiatement après, s'est manifestée une
spiration très abondante et ruisselante, à la suite de laquelle le
val a paru se ranimer et sortir de son abattement.

Pendant toute la nuit, la température s'est maintenue à 39° jusqu'au
ın.—Le matin, le cheval était faible, sans appétit, sa respiration

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* Avec W. Bull: Le Caire, 1876.

était saccadée; on a répété la dose de quinine ainsi que l'injection de la solution d'acide carbolique. Le soir, la température était montée à 40°. Le lendemain, 40½. Le cheval a alors commencé à tousser fortement et souvent. Cette toux était suivie d'oppression. La respiration devenant de plus en plus difficile, et le cheval faisant de grands efforts pour aspirer l'air, un vétérinaire assistant s'est décidé à faire une trachéotomie qui n'a pas modifié le symptôme. Pour rendre un peu de forces au cheval, on lui a fait boire une bouteille de vin.

Plus tard, le cheval, qui jusque là avait été tellement calme qu'on avait pu le laisser dans sa stalle sans être attaché, a commencé à être inquiet et à marcher dans l'écurie, butant contre les obstacles, cherchant à les éviter, avançant et reculant jusqu'à ce qu'il tombât et enfin expirât après quelques convulsions, le troisième jour de sa maladie, à onze heures du soir.

AUTOPSIE Le 26 Septembre, a six heures du matin (sept heures après la mort)

La diagnose après l'autopsie:

1. Angine.
2. Pharyngite catarrhale.
3. Laryngite.
4. Trachide.
5. Bronchite capillaire.
6. Pneumonie lobulaire multiple aiguë.
7. Apoplexie multiple des poumons.

8, 9, etc. Dégénération parenchymateuse du cœur, du foie, des reins, des muscles, des membranes muqueuses du ventre et des glandules salivaires.

Le corps est rigide, les tissus cellulaires sous-cutanés sont bien formés et d'un aspect naturel, pas œdémateux ni infiltrés. Pas de mucosités dans la bouche; la langue et les gencives un peu injectées, avec quelques ecchymoses; sauf cela, la membrane muqueuse naturelle. A la racine de la langue, on trouve dans les grands fossés des glandules, des ecchymoses de la grandeur de la tête d'une épingle et les replis glossoépiglottiques relâchés et ridés comme après un œdème dans un tissu cellulaire submuqueux. La membrane muqueuse, dans cette partie, ainsi que dans l'isthmus faucium, est rouge, brunâtre, injectée et imbibée, et à la place des amygdales, on en trouve une partie de la grandeur de dix centimètres carrés, gonflée et couverte d'ecchymoses d'une dimension variant de la grosseur d'une tête d'épingle à celle d'un grain de chènevi et confluantes.

Sous le microscope, on voit la membrane muqueuse de ces diverse parties couverte de son epithelium qui est certainement sur la surface un peu excorié, mais normale dans sa profondeur et ne présentant d'infiltra tions ni avec exsudat diphthéritique ni avec cellules de pus.

Sous l'épitèle, on trouve les vaisseaux sanguins remplis de sang et le issus qui les entourent infiltrés avec des leucocutes ou des cellules néolastiques (inflammation) ou avec des globules de sang qu'on voit dans es ecchymoses agglomérés irrégulièrement.

Dans le tissu submuqueux, on voit le sang extravasé, mais on ne onstate pas d'inflammation.

Dans les glandules muqueuses, on trouve les cellules à leur place, nais gonflées et si fortement granulées que les noyaux sont difficiles à listinguer isolément, même sous l'influence de l'acide acétique (*altéation parenchymateuse des glandules*).

Les glandes salivaires sont d'un extérieur naturel à l'œil nu, mais au nicroscope on trouve les cellules sécrétoires granulées, mais aucune nflammation dans le tissu interstitiel.

Epiglotte.—La membrane muqueuse de l'épiglotte du ligamentariénoépiglottique et des cartilages ariténoïdères est fortement injectée et ouverte d'ecchymoses éparpillées de la dimension d'une tête d'épingle.—Sous le microscope, la couche superficielle des cellules de l'epithelium est disparue, mais les couches profondes ne sont pas altérées.

Dans le tissu propre de la membrane muqueuse, ainsi que dans le tissu sub-muqueux jusqu'à la surface du cartilage, se trouve une hypérémie et une augmentation des cellules cytoblastiques et des globules de sang extravasé dans ce tissu.

Dans le tissu cartilagineux de l'épiglotte, rien d'anormal.

Larynx-trachée.—L'intérieur du larynx jusqu'aux vraies cordes vocales qui sont un peu rouges, sans être par trop gonflées, est lui-même d'un rouge foncé injecté, avec des ecchymoses *sans plaies ni exsudat*.

Au-dessous des cordes vocales, la membrane muqueuse est plus pâle, seulement tachetée d'ecchymoses espacées; plus bas, elle est couverte de mucosités, et vers le milieu du tube on constate une mucosité grisâtre, légèrement adhérente, et qui se détache facilement au contact de l'eau. Sous le microscope, ces mucosités sont composées de petites cellules rondes *leucocytiques*, mêlées à des cellules de l'épitèle cylindrique, mais non réunies entre elles par des masses fibrineuses et adhérentes (*exsudat qui n'est pas croupeux mais catarrhal*).

Sous le microscope, on voit dans la membrane muqueuse les mêmes, phénomènes que nous avons constatés sur l'épiglotte.

Dans la partie inférieure de la trachée, les mucosités et les ecchymoses sont moindres; le tissu sub-muqueux est un peuœdémateux et on trouve des ecchymoses entre les veines qui sont remplies de sang.

Poumon Droit.—Dans le sac du pleura il n'y a pas de liquide séreux. Le poumon droit est sans adhérence. Le pleura est lisse, peu injecté; ependant, sur la partie postérieure, on constate que les veines sont emplies hypostatiquement.

Sur la surface des poumons, on trouve partout des parties lobulaires, ispersées, rouge foncé, dures, proéminentes, de la grosseur d'une noisette. n coupant ces parties, le tissu des poumons est foncé, brunâtre, rouge, ranulé, sans air, peu résistant sous la pression du doigt, couvert d'echymoses et de taches blanc-grisâtres, entourées d'ecchymoses. En coupant le tissu des poumons et en le pressant, on fait sortir des bronches une mucosité épaisse, jaunâtre et puriforme. La membrane muqueuse des bronches est injectée avec des ecchymoses. (*Bronchite capillaire.*)

Dans l'apex du poumon droit, se trouve une partie d'une longueur de douze centimètres et d'une largeur de sept centimètres, occupant toute l'épaisseur du poumon; le tissu est sans air, rouge foncé, constellé de taches grisâtres, et sous le couteau sort un liquide sanguineux puriforme, couleur chocolat. (*Première phase d'une pneumonie aiguë lobulaire.*)

Soumis au microscope, ce liquide se compose de petites cellules (leucocytes), mêlées de globules de sang rouge.

Dans le tissu du poumon, on trouve également beaucoup d'ecchymoses de la grosseur d'une noisette, de la couleur de sang foncé, très souvent avec une petite tache rouge-grisâtre. (*Pneumonie aiguë lobulaire dans le milieu de l'ecchymose.*)

Poumon Gauche.—Dans le sac du pleura il n'y a pas de liquide séreux. Le pleura gauche est plus rempli de sang que le pleura droit. Les pneumonies lobulaires se présentent en plus grande abondance. Le tissu du poumon est rempli de sang et peu résistant sous la pression du doigt. Sauf ces symptômes, nous retrouvons les mêmes phénomènes que nous avons signalés dans le poumon droit.

La membrane muqueuse dans les grandes bronches est très injectée, couverte d'ecchymoses longitudinales entre les fibres longitudinales, mais n'est pas trop couverte de mucosités.

Sous le microscope, on voit les vésicules pulmonaires des pneumonies lobulaires remplies de cellules rondes (leucocythes), agglomérées sur divers points, mêlées à des globules de sang rouge; on trouve également dans quelques-unes des vésicules pulmonaires des masses granuleuses composées de granulations fines qui ne se changent pas sous l'action de l'acide acétique, qu'il soit employé faible ou fort (zooglœa).

Dans le tissu des parois, entre les vésicules, on trouve les vaisseaux remplis de sang, mais aucune augmentation du nombre des noyaux et des cellules.

Dans les ecchymoses qui entourent les pneumonies lobulaires, on voit les vésicules remplies de globules de sang rouge ou éclatées et le tissu du poumon déchiré par la pression de la masse de sang.

Le Péricarde.—On trouve dans la cavité du péricarde 200 grammes d'un liquide séreux rougeâtre.

Sur le péricarde pariétal, surtout sur l'artère pulmonaire, on voit des ecchymoses dispersées, mais nulle part on ne constate d'exsudat inflammatoire.

Le Cœur.—Le ventricule droit est un peu flasque, le péricarde est un peu opaque; le ventricule gauche est contracté et dur. En coupant, on voit la musculature d'un blanc-gris, opaque, comme trempée dans l'alcool ou cuite. Cet aspect grisâtre de la musculature est encore plus prononcé dans l'atrium qui est flasque. Dans la cavité du ventricule gauche se trouvent 100 grammes de sang foncé, liquide, mêlé à des coagules foncés. L'endocarde est un peu opaque, mais sans ecchymoses.

Le ventricule droit est dilaté. Dans sa cavité, on trouve du sang quide, d'un aspect foncé et de grandes coagules fibrineuses jaunâtres. uand on coupe la paroi, la surface en est grisâtre, peu résistante, opaque, ans ecchymoses.

Les valvules sont imbibées de sang mais saines.

Les fibres de la musculature du cœur, vues au microscope, sont parenhymateuses, dégénérées, c'est-à-dire que les fibres longitudinales sont ellement granulées qu'on ne peut apercevoir ni les stries transversales i les stries longitudinales.

Cavité Péritonéale.—Pas de liquide; le péritoine est normal; les inestins un peu trop remplis d'air; ce qui se manifeste par la projection es intestins lors de l'ouverture faite dans l'abdomen avec le couteau.

Rate.—La rate est d'une forme et d'une dimension normales; la apsule d'un gris blanc, un peu ridée; la pulpe obscure, pas trop remplie e sang d'un brun rougeâtre, un peu flasque, peu résistante sous le doigt, arce que la pulpe rouge sort entre les fibres comme une pâte liquide. as d'ecchymoses.

La pulpe a sous le microscope les éléments cellulaires grands et petits ans un état normal mêlés à des cellules de pigment.

Le Foie.—Forme et dimension normales. La surface est lisse, les uites des bords sont prononcées; on constate un certain nombre d'adérences filiformes.

Sur la surface convexe du petit lobule du milieu, se trouvent certaines arties de la grosseur d'une noisette qui sont obscures et qui sont remplies e sang.

Si l'on fait une incision dans le tissu, la surface est très opaque, d'un ris foncé; le doigt y pénètre facilement, chaque lobule est difficile à istinguer. Sous le microscope on voit les cellules du foie si fortement ranulées que les noyaux sont invisibles; de plus on constate qu'un bon ombre des cellules est rempli de gouttes de graisse.

Ventricule.—Les membranes muqueuses sont normales. Le ventriule est dans la moitée du Cardia blanc et normal, mais dans la moitée u pylorique grisâtre, opaque, imbibé de sang et on trouve cinq ecchyoses de la grosseur d'une noisette.

La membrane muqueuse du ventricule vue au microscope donne les ellules glandulaires ainsi que les cellules de l'épitèle opaque, légèrement ranulées rarement avec des noyaux visibles.

Duodénum.—La membrane muqueuse est grisâtre, normale, pas onflée, l'épitèle un peu opaque, du reste normal.

Petit Intestin.—Dans la partie de mésentére qui touche aux inestins, on rencontre quelques ecchymoses de la grandeur d'une pièce de inq francs; sur la partie de la membrane muqueuse correspondant au mésentére rien d'anormal.

Dans les autres parties, (les plaques de Peyers, follicules solitaires), l n'existe pas de gonflement, seulement la couleur de la muqueuse est risâtre. La membrane muqueuse normale, un peu opaque.

Cecum.—Il contient des excréments peu solides et des aliments non igérés. Le membrane muqueuse est remplie de sang et couverte 'ecchymoses. Les grandules solitaires ne sont pas gonfleés.

Colon.—Grisâtre, mais rien d'anormal. Dans le colon adhérent la membrane muqueuse est un peu plus injectée de sang mais sans ecchymoses.

Rectum.—La membrane muqueuse n'est pas trop injectée de sang, mais un peu congestée vers l'anus.

Vessie.—Ne contenant qu'environ 50 grammes d'urine jaunâtre à l'état normal. Seulement des traces d'albumine.

Reins.—Dans la capsule extérieure, on constate des ecchymoses fraiches, la capsule se détache facilement.

En l'enlevant, on déchire le tissu des reins; en coupant on voit le cortical grisâtre et opaque. Les glomeruli sont remplis de sang et se voient comme des points rouges et très fins. Les pyramides sont plus remplies de sang et le tissu plus rouge foncé.

Les calices et le Bassin contiennent un liquide d'un blanc jaune puriforme et muqueux qui sous le microscope se compose de cellules épithéliales cylindriques et de quelques cellules *leucocytiques* rares.

Le tissu des reins sous le microscope est presque à l'état normal, les cellules de l'épitèle des canaux courbes er étroits, sont è leur place avec le noyau facile à distinguer, seulement la masse de protoplasme qui entoure le noyau est un peu plus granulée que dans l'état normal.

Cerveau.—La dura mater est normale, les vaisseaux de pia mater sont très peu remplis de sang, sans ecchymoses et sans liquide dans les cavités subarachnoïdales. Dans les ventricules de côté, pas de liquide.

L'épendume est normale. La masse grisâtre et blanchâtre du cerveau est un peu flasque, humide, très peu remplie de sang.

Tela corioïdea remplie de sang sans ecchymoses. Le cervelet et les grands ganglions sur la base sont dans l'état normal.

Œil.—Sur la membrane muqueuse des conjonctives plusieurs ecchymoses, le reste normal. Les parties profondes du globe de l'œil sont dans l'état normal.

Les muscles du corps et les extrémités ont l'aspect et la couleur normaux; mais sous le microscope, on trouve quelques fibres normales et quelques autres si fortement granulées qu'on ne peut distinguer ni les stries longitudinales ni les stries transversales.

Les glandes lymphatiques de tout le corps se trouvent dans l'état normal, ni gonflées ni injectées, ni contenant des bachtérides.

Le sang, pris du ventricule gauche du cœur a la même composition que celui extrait des gencives six heures avant la mort (soit avec addition de solution de sel marin, soit sans addition); les globules rouges et blancs, sont à l'état normal, comme forme, couleur et dimension. Les globules rouges sont empilés, et entre eux on ne distingue de bachtérides ni ronds ni d'autre forme. Le même résultat négatif est constaté par notre savant confrère, le docteur Abbate Bey.

Nous nous permettrons d'ajouter un mot au sujet d'un cheval attaqué de la maladie le matin et qui est mort le soir même, et dont l'autopsie est faite deux heures après la mort, pour constater les altérations pathologiques de la première phase de la maladie.

Nous avons trouvé le catarrhe avec des ecchymoses dispersées dans l'arrière bouche, la langue, la trachée, les bronches et sur la surface des poumons plusieurs ecchymoses d'une dimension variant de la grosseur d'une noisette jusqu'à celle d'un œuf, et seulement dans quelques-unes de ces petites ecchymoses des parties décolorées, blanches-grisâtres au milieu. En glissant avec les doigts sur la surface, on trouve plusieurs parties en saillie dures; en faisant une incision, la surface de celle-ci est d'une couleur rouge foncé à la périphérie et au milieu rouge grisâtre. Dans le tissu, on voit des apoplexies rouge-foncées de ladite grandeur et, en outre, en serrant le tissu qui contient de l'air entre ces apoplexies, la mucosité sort des bronches les plus petites (bronchite capillaire). Les parties postérieures sont tellement infiltrées de sang, que le tissu est rouge-foncé, vide d'air, dur, mais en même temps peu résistant sous le doigt. Engouement hypostatique.

Les autres organes ont la même altération parenchymateuse que nous avons vue dans l'autre autopsie.

Nous n'avons trouvé ni des plaques diphtéritiques, ni croupeuses; ce qui prouve que la maladie n'est ni diphtéritique, ni croupeuse. Nous n'avons pas vu la rate agrandie; ce qui prouve que nous n'avions pas affaire à un typhus. Ce n'est pas une maladie charbonneuse, parce que les glandes lymphatiques ne sont pas attaquées; mais nous avons sous les yeux une maladie d'infection, un empoisonnement du sang, qui se localise dans les organes respiratoires comme un catarrhe de l'arrière-bouche: le larynx, la trachée, les bronches comme des pneumonies lobulaires multiples et des apoplexies dans les poumons.

Le caractère d'infection de la maladie se révèle par la dissolution du sang qui produit les ecchymoses partout dans les organes respiratoires, ainsi que dans le péricardium, le colon, le mésentére et par les altérations parenchymateuses du foie, du cœur, de la rate, des reins et de la membrane muqueuse des intestins.

Ainsi que nous l'avons dit, la maladie, depuis deux mois qu'elle sévit au Caire, a enlevé à peu près les deux tiers des chevaux.

Dans l'Hippodrome et dans les écuries de Boulaq, sur 98 chevaux, 65 ont été attaqués et 7 seulement ont été guéris; dans l'écurie de M. Billiet, sur 65 chevaux, 40 attaqués, et on n'a réussi, malgré tous les efforts tentés, qu'à en sauver un seul.

La durée de la maladie varie de un à quatre jours.

Jusqu'à présent, il a été difficile, pour ne pas dire impossible, de guérir la maladie; notre attention sera alors premièrement de chercher les moyens pour arrêter l'épidémie dans sa marche et prendre des précautions prophylactiques afin de sauver, autant que possible, les chevaux non attaqués.

Nous n'avons pas à nous occuper des grandes mesures administratives, qui sont les mêmes dans toutes les épidémies, et qui appartiennent aux administrations sanitaires et gouvernementales, nous voulons seulement indiquer les mesures les plus essentielles à observer par les propriétaires de chevaux.

Les mesures à prendre seront alors d'empêcher le poison, qui est probablement dans l'air, d'agir et d'entrer dans le corps du cheval.

L'autopsie nous a fait voir que ce sont les organes respiratoires qui souffrent principalement; le but de notre travail sera par conséquent d'empêcher le poison d'entrer en contact avec les membranes muqueuses respiratoires.

A cette intention, nous avons fait construire des muselières en toile doublée. Entre les deux parois, on place du coton trempé dans une solution d'acide phénique et d'acide salicique et séché. Le sac serre complétement au moyen d'un élastique à la tête du cheval, et permet ainsi à l'air d'entrer seulement après avoir passé et avoir été filtré dans les couches de coton désinfectant.

Le cheval reste ainsi la nuit comme le jour.

Quant à la nourriture, on a seulement à faire venir toujours l'eau d'un endroit non infecté. De l'eau prise d'une sakie près de l'endroit où on enterre les chevaux ou des écuries infectées est dangereuse.

L'isolement des chevaux pour qu'ils ne viennent pas en contact avec les miasmes contagieux est nécessaire. Il faut retenir les chevaux dans l'écurie aussi longtemps que durera l'épidémic, afin qu'ils ne viennent pas en contact avec des chevaux infectés ou des endroits de la rue infectés.

On défendra l'entrée de l'écurie saine aux cochers et domestiques qui n'y sont pas employés. Les employés de l'écurie se laveront de tempts en temps les mains avec une solution d'acide carbolique.

Il faut tenir l'écurie bien propre, arroser trois fois par jour avec une solution d'acide phénique et de chlore liquide et y faire brûler du soufre.

Une écurie dans laquelle il y a eu des cas de maladie doit être enduite de mortier et blanchie. On y fera des fumigations de soufre pendant quarante-huit heures.

Nous avons en l'occasion d'essayer pratiquement ces mesures et de voir leur efficacité dans une écurie située au centre de l'épidémie, éloignée seulement d'une distance de 50 à 400 mètres des écuries dans lesquelles l'épidémie existait, et nous avons constaté que jusqu'aujourd'hui les chevaux ne sont pas atteints.

DIFFUSE MULTIPLE CAPILLARY FAT EMBOLISM OF THE LUNGS AND BRAIN AS A FATAL COMPLICATION IN COMMON FRACTURES, ILLUSTRATED BY A CASE*

WITH J. H. SALISBURY, M.D.

In calling your attention to the above-named serious but very rare isease, we shall first quote the history and postmortem examination of case observed last summer in Dr. E. W. Lee's surgical ward in Cook County Hospital, and afterward make some general remarks on the main features of the subject.

History.—The patient, Mrs. B., a housewife, aged forty-five, and a native of Ireland, as admitted to Cook County Hospital July 25, 1879.

On admission, the patient stated that she had fallen from the roof of a kitchen to the round, a distance of 3 meters, striking upon her left side. On examination, evidences of a acture of the upper part of the shaft of the left femur were found.

The leg was placed in a comfortable position, but no permanent dressing was applied. Morphin was given *pro re nata.*

July 26th: The patient was very restless, but did not complain of much pain.

July 27th: In the morning the patient seemed to be sleeping quietly, but the respirations were quite rapid; 1 P. M., the patient was still unconscious; she could be roused somewhat, but did not become conscious; the pupils responded to light; 5 P. M., she had some slight spasms; the jaws were firmly set for a few minutes; 7 P. M., pulse 112, somewhat weak; temperature, 38.5° C. (101¼° F.); respirations, 40 per minute, regular. The patient was still comatose, face pale, lips slightly bluish. The movements of the thorax were natural. Upon percussion, the dullness of heart, liver, and spleen was found to be within the regular boundaries. Auscultation showed the sounds of the heart to be normal. Over the lungs the normal vesicular breathing was heard. No râles were heard, either th inspiration or with expiration. The posterior parts of the lungs were also natural. e abdomen was natural. The pupils responded to light, and were equal in size. ere was no local paralysis in any part of the body. The urine contained no albumin.

July 28th: The symptoms were about the same, except that all over the lungs were rd the coarse râles which usually occur in the agony.

Dr. Fenger saw her, and made the diagnosis of diffuse multiple capillary fat embolism the lungs. Prognosis, fatal.

She died in the afternoon of July 28th.

Dr. Salisbury noticed about the patient an indescribable sweetish odor.

Autopsy.—To the coroner, General Mann, we owe our thanks for his kindness, which abled us to hold the exceedingly interesting postmortem. There were present General

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* Chicago Med. Jour. and Examiner, 1879, vol. xxxix, p. 587. Read before the Chicago Medical Society, November 17, 1879.

Mann, Drs. McWilliams, Merriman, and Lee, of the hospital staff, besides the internes of the hospital.

The autopsy was made twenty hours after death. The rigor mortis was well marked. The subcutaneous adipose tissue was abundant. The striated muscles appeared natural. In the pericardium was found about 15 c.c. of thin yellow fluid. The heart was natural in shape and size, but flabby. The valves and endocardium were natural. The heart muscle was somewhat grayish. The heart and large vessels contained dark fluid blood, as in strangulation. Small drops of fat were found swimming on the blood. Some old adhesions existed in the left pleural cavity. Nothing abnormal was found in the pleura costalis nor in the pleura pulmonalis. In the subpleural tissue were many small ecchymoses up to the size of a pinhead.

The surface of the left lung had a peculiar red, spotted appearance, which was most marked in the anterior parts of the lobes. The cut surface of the lung presented the same appearance. Some parts were quite white, which was due partly to anemia but chiefly to emphysema along the anterior borders.

The posterior part of both lungs was congested and somewhat edematous. There was no capillary bronchitis. The bronchial mucous membrane was somewhat injected, but there were no ecchymoses and no mucus except in the largest tubes.

In one place, at the base of the lower lobe of the right lung, were some larger ecchymoses. These ecchymoses were mostly subpleural. The cranium was rather thick, but otherwise natural. The dura mater was natural. The lateral ventricles contained a little clear serous fluid. The brain tissue of the hemispheres was natural, and not particularly anemic. On the cut surface of the hemispheres, especially in the white substance, were found numerous ecchymoses, appearing as small, round, dark, blood-red points, varying in size from points scarcely visible up to 1 mm. in diameter. These were found all through the white substance, and a few were found in the gray. The same spots were found in the cerebellum, and a group of them in the anterior part of the pons varolii and some in the corpus callosum. The vessels at the base of the brain were natural. The substance of the large ganglia was natural.

No fluid was found in the abdominal cavity. The peritoneum was natural. The spleen was of natural shape and size, but on the surface were seen several small, dark, irregularly shaped spots, 4 mm. in diameter, which seemed to be superficial hemorrhages.

The liver was grayish and anemic, but there were no ecchymoses. The kidney was of natural shape and size, flabby, but otherwise normal. The uterus and bladder were normal. In the fundus of the stomach were small ecchymoses in a limited space of 2.5 cm. in diameter. Otherwise the mucous membrane of the intestines was normal. In the upper part of the left femur, between the first and second third, was a complete transverse fracture, surrounded by the usual amount of coagulated blood, filling the surrounding intermuscular spaces. The substance of the fractured bone was normal. The marrow in the canal of the shaft was yellow from infiltration with fat, as we usually find it in elderly persons. No traces of inflammation were seen in or around the fracture. There were no coagula in the larger of the surrounding veins. The femoral vein contained dark fluid blood with no visible fat-drops in it.

Microscopic examination showed the following interesting features:

Small pieces cut off with the scissors from the surface of the lung showed the smaller arteries and some of the capillaries of the pleural tissue as a whitish-yellow, refracting network, owing to the injection and filling up of those vessels with liquid fat. Sections from the interior of the lung tissue showed a fine, more or less complete injection of liquid fat in the network of capillaries surrounding and protruding into the air-cells.

The sketches show the above-mentioned features:

Fig. 12 shows one complete air-cell, A, and three incomplete ones, B, C, D. In the interstitial tissue between these four air-cells you see, besides the usual characteristic elastic fibers, a light network of injected capillaries, a loop of which protrudes at E and F in high relief from the internal wall of the air-cell; at G, part of the network of capillaries at the bottom of the air-cell is visible, on account of the injection with fat.

Fig. 13 shows an almost complete injection of the capillary network at the bottom of the air-cell, A. In the interior of this network we find the homogeneous aspect of the fat, interrupted by small, round, granular bodies of the size of a white blood-corpuscle The above-mentioned small bodies may be either white blood-corpuscles, still clinging to the wall of the capillary after the oily fat has set in, or leukocytes brought up with the fat from the marrow, where they are usually found in great numbers.

The specimens we hereby show in the microscope do not exhibit the above-described condition so distinctly now, because the fat, in the course of the elapsed three months, has, in most places, run out from the cut branches of the capillaries and shows itself now as round, refracting fat-drops scattered all over in the tissues. Still, the capillary injection is visible in some places and the filling up of the smaller arteries with fat can be easily enough recognized—as shown in the microscope with the low power. In another microscope we show a section of the lung tissue with empty capillaries only to call attention to the fact that here the capillaries are not visible at all, and, unless the capillaries are filled with blood or some colored artificial injecting fluid, we will not be able to see a trace of them. The microscopic examination of the small hemorrhages in the brain tissue showed the subcapillary arteries in the center of the hemorrhage filled with fat in the same manner as in the lungs. In none of the other organs of the body were we able to discover any fat in the smaller vessels.

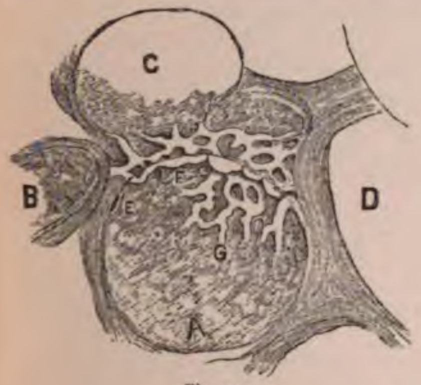

Fig. 12.

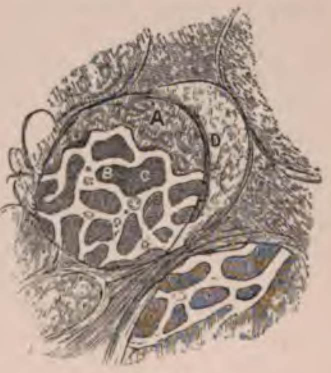

Fig. 13.

Upon adding osmic acid in the sections of lung tissue, the fat in the vessels is colored black and the vessels then appear as if they were filled with some black injecting fluid. This renders the demonstration of the presence of fat much easier than by the examination of unstained specimens.

We are indebted to the kindness of Dr. Merriman for part of the literature concerning this subject, viz., the Medical Record, of New York, July 19, 1879, where two fatal cases of fatty embolism in fractures are briefly stated.

As far as we remember, the first observation was made in Germany, in 1862, by the renowned pathologist, Prof. Zenker. Attention once called to the danger of liquid fat from the marrow of fractured bones gaining access to the veins and causing obstruction of the lung capillaries, numerous examinations were made of the lung tissue in occasional deaths after fractures and other lesions, and it was found (Orth[*]) that fat embolism in the lungs occurs in almost every case of extensive fracture of the bones. It is, however, in only a very small number of fractures that the amount of fat entering the circulation is considerable enough to prove fatal, or even to give recognizable disturbances in the course of common uncomplicated fractures.

Further investigations by Flournoy and von Recklinghausen in the necropsy theater at Strasburg showed that slight diffuse fatty embolism could be found in 10 per cent. of a series of 260 dead bodies. Up to 1879 Egli Sinclair[†] had gathered records of 140 reported cases, and he found the etiology to be limited to one of the following three morbid conditions: (1) Extensive contusion or laceration of soft parts, containing abundance of adipose tissue. (2) Fracture with extensive lesion of the marrow of the bones. (3) Osteomyelitis—chronic as well as acute inflammation of the marrow of the bones.

The most severe cases of fatty embolism, however, set in after fractures; *e. g.*, in 140 cases death ensued in 18; that is, 13 per cent. Of these 18 deaths, 16 occurred in the 84 cases of fracture.

Symptoms and Diagnosis.—The symptoms, as Egli Sinclair gives them, from cases of fatty embolism in extensive fractures, are as follows: Unexpected, rapidly increasing, general debility; then the symptoms from insufficiency or entire absence of oxidation of the blood; respirations from 40 to 60 in the minute; pulse weak and frequent; temperature often somewhat augmented. Râles in the larger bronchi, and finally in the trachea (premortal). Dyspnea sometimes to the highest degree; then reddish foam coming out of the mouth. The face grows pale, later cyanotic; the extremities get cold, pupils contracted. The patient becomes somnolent, finally comatose, and death ensues, sometimes preceded by vomiting and spasms.

The diagnosis in the case which we have related was based on the following reasoning:

We had before us a previously healthy person with a simple, uncomplicated fracture of the femur that, from the beginning, promised to run the usual benign course toward healing. The second day, except some restlessness, there was nothing to indicate the approaching danger. The third morning she was found in a comatose condition, which had set in without any previous suffering sufficient to waken her from her sleep, which means that the grave symptoms, as usual in these cases, set in suddenly. Besides this comatose condition, we find no fever of any account. A temperature of 101¼° F. is the usual aseptic and innocent rise in temperature that will be found (Volkmann, in 11 out of 14[‡]) in most of the fractures of the femur not treated with immovable dressings.

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[*] Orth: Diagnosis in Pathological Anatomy, translated by Shattuck, New York, 1878, p. 160.

[†] Egli Sinclair: "Ueber Fettembolie," Correspondenzbl. f. Schweizer Aerzte, vol. vi, 1879; St. Petersburg med. Wochenschr., 1879, No. 23; Allgemeine med. Central-Zeitung, Berlin, 1879, p. 683.

[‡] Volkmann: "Ueber septisches und aseptisches Wundfieber," Sammlung klin. Vorträge, p. 1023.

The physical examination does not show any morbid symptom in the organs of the thorax and the abdomen. The urine shows that there is no disease of the kidneys and no diabetes. As to the brain, we find no symptoms of a local disease. There is no paralysis, equal pupils, and no symptoms of pressure, such as stertorous breathing, etc.

The only positive symptoms able to lead attention in the direction of the seat of serious trouble were the cyanosis, paleness of the face, bluish hue of the lips, and the augmented number of respirations—40. These symptoms evidently pointed to the lungs. As now the air-cells as well as the bronchi were normal, we must place the trouble in the circulatory system of the lungs—thrombosis or embolism in a great part of the pulmonary vessels.

A spontaneous thrombosis in the trunk and branches of the pulmonary artery can take place in endarteritis of this artery. But this disease is as seldom found here as is endocarditis in the right heart. Embolism could occur from a loosened thrombus in any part of the venous system from the right ventricle or auricle, but here was no previous heart disease and no previous exhausting febrile disease.

The only peripheral diseased place to be found was this recently fractured femur. Around a fracture, thrombosis in the larger veins is not uncommonly found (F. Durodié*). The thrombi from the smaller veins formed around every fracture extending out into larger and larger veins, causing probably part of the edema accompanying so many fractures of the extremities. Loosening of part of these thrombi and subsequent embolism of the lungs are rare, but take place in 1 case out of 300 (Durodié). A sufficiently large aseptic embolus in both of the main branches of the pulmonary artery might give a similar series of symptoms ending in death. But the formation of these peripheral venous thrombi and their subsequent detachment and entrance into the circulation take a much longer time than forty-eight hours, and consequently we were obliged to abandon this explanation of the symptoms. Finally, there was left no other diagnosis that would correspond to the symptoms of the case than the fatty embolism of the lung capillaries, *i. e.*, the introduction into the circulation of liquid fat in sufficient quantity to make the greater part of the lung capillaries impassable for the blood. The moderate acceleration of the pulse and the not extreme cyanosis are easily explained by the difficult passage of the blood through the lungs from the venous system overfilled with blood. The weakness of the radial pulsation is a natural consequence of the diminished quantity of blood in the arterial system. The comatose condition may be explained by the want of blood-supply to the brain and the medulla oblongata (Wagner†), probably combined with accumulation of carbonic acid in the blood. Whether the multiple capillary embolism in the brain in our case contributed to the depression of the cerebral functions or not cannot be decided.

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* F. Durodié: "Étude sur les thromboses et l'embolie veineuses dans les contusions et les fractures," Thèse, Paris, 1874.

† Wagner: Manual of General Pathology, translated by Van Duin, New York, 1876, p. 209.

In a number of the reported cases of this kind the fatty embolism has caused sudden death (Wagner, *loc. cit.*).

In one of Déjérine's cases death occurred in two and one-half hours; in the other, thirty-six hours after the fracture was received. The report of his cases does not give any information about the duration of the grave symptoms. About this we cannot tell anything for want of the original reports of previous cases. Our case, though fatal, did not take a very rapid course, which was so far interesting as it gave sufficient time (the grave symptoms lasted over thirty-six hours) to have the diagnosis based upon a minute examination of the symptoms.

Prognosis.—The prognosis depends upon the quantity of the circulating fat and upon the strength of the heart's action. If the right ventricle can get and keep up power enough to push the fat through the lungs, then the immediate danger will be overcome. An extensive fracture, as the source of the embolism, will make the prognosis worse 20 to 40 per cent. than lacerated soft tissues or osteomyelitis.

Treatment.—The natural treatment will be to stimulate the action of the heart in the hope that an increased *vis à tergo* can drive part of the fat through the lung capillaries out into the aortic system (digitalis, alcohol, etc.). When the immediate danger from the pulmonary system can be overcome, then the organism will gain time to get rid of the fat, presumably by transforming it into soluble soaps through the action of the alkalis in the blood. Merely hypothetically, we should advise to keep the fractured bone or the diseased part scrupulously immovable, with the view of preventing any more liquid fat from escaping from the tissues. As to this point, we must remember that in the marrow as well as in the adipose tissue the fat is contained in so-called fat-cells, *i. e.*, membranous sacs. These membranes must be destroyed or torn open before their contents of liquid fat can gather in a fluid, movable mass, and it is in this condition of the fat that the danger lies, as we do not find the fat-cells or sacs, but only their contents, in the capillaries of the lungs.

RUPTURES OF THE SUBPUBIC PORTION OF THE URETHRA*

WITH E. W. LEE

TRAUMATIC RUPTURE

THE great danger to life following complete traumatic rupture of the rethra is fully appreciated by modern surgeons. The main interest, owever, depends not so much on the resulting morbid conditions as on he fact of our ability to prevent grave consequences by proper treatment, provided the case is intrusted to our care early enough after the ccident. We shall first relate a typical case of complete traumatic upture, and afterward quote from recent surgical literature on this ubject:

CASE.—John Hansen, aged fifty-three, laborer, was brought into Cook County ospital on the morning of the ninth of August, 1879, and placed under the care of Dr. enger, and the following history was elicited:

Patient states that yesterday afternoon he fell from a scaffold, and in his descent ruck the perineum across a joist. He was taken to his home and a doctor (Dr. Jacobson, f the Cook County Hospital staff) was sent for. On his arrival the doctor tried to introduce a catheter, but immediately finding an impassable obstruction in the bulbous porion of the urethra, which was bleeding freely, he advised his removal to the hospital. Since the accident he has been unable to pass any urine, but considerable blood has passed rom the meatus urinarius. Patient complains of severe pain in the perineum and over he hypogastric region, *i. e.*, he suffers from constant urinary or vesical tenesmus, desiring to pass his water, but being unable to do so.

On examination, percussion-note is found dull over hypogastric region, extending rom the symphysis pubis below to the umbilicus above. The bladder, greatly distended ith urine, forms a fluctuating tumor in the median line of the above-named region of the domen. The perineum is somewhat swollen and tender to the touch, and of a dark ish color from subcutaneous ecchymosis. The discoloration extends forward over posterior half of the scrotum and down the inner side of both femora for a distance two inches, but no swelling of the tissue exists.

The house surgeon tried to pass a No. 7 or 8 soft-rubber English catheter, but was able to do so. The urine was withdrawn with an aspirator, the needle of which was sed into the bladder above the symphysis pubis in the median line. About three pints lear healthy urine was removed, followed by immediate relief to the patient. Pulse, 60; perature, 99° F. No pain while lying quietly in bed.

August 9th: This afternoon perineal section was performed. The patient was anhetized by ether and placed in the lithotomy position, with flexed and abducted femora, and the perineum drawn over the lower end of the bed. A curved silver catheter was passed into the urethra until it reached the obstruction, where it was retained in position. An incision two and a half inches in length was now made in the median line of the perineum, extending through the integuments and the bloody, infiltrated subcutaneous tissue. No urine or pus escaped from the incision. The corpus spongiosum of the bulbous portion of the urethra was now divided, and search made for the end of the catheter, which was found in a cavity filled with dark, clotted blood. After the removal of the clots the cavity was found to be very irregular, half an inch in breadth and one inch long, and the walls consisted of ragged, torn, and bleeding tissue, among which no recognizable traces of the wall of the urethra could be found. The anterior part of the urethra through which the catheter passed showed, at its outlet into the cavity before mentioned, an irregular opening in which no part of the urethral wall could be traced into the wall of the cavity. As the rupture consequently was a complete one, involving the whole circumference of the urethral canal, search was now made to find the opening into the posterior portion of the urethra. After some time passed in vain these efforts were relinquished, and every portion of clotted blood was carefully removed, and the wound left as above described, as we desired and expected the free escape of urine through the perineal orifice. The withdrawal of the catheter was followed by slight bleeding from the meatus urinarius. The perineal wound was covered with soft lint, previously steeped in a 5 per cent. carbolized linseed-oil dressing, and this was kept *in situ* by a piece of oakum placed between and behind the upper part of the femora. At night a subcutaneous injection of morphin was given.

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* Chicago Medical Gazette, 1880, vol. i, p. 63. By the subpubic part of the urethra meant all the bulbous portion and that part of the membranous portion immediately front of the triangular ligament.

August 10th, A. M.: Pulse, 72; temperature, 101¼° F. Slept some during the night; slight pain in the perineal wound; as yet no urine passed. P. M.: Pulse, 84; temperature 101⅖° F. He is still unable to pass his water; suffers again from urinary tenesmus; the bladder is distended to within two inches of the umbilicus; no swelling or tenderness in the perineum. The urine was again withdrawn per aspirator.

August 11th, A. M.: Pulse, 84; temperature, 100½° F. Aspirated the bladder again this morning. The patient was again anesthetized by ether; placed in the same lithotomy position, the light of the sun falling directly upon the perineum. The perineal wound was now dilated backward, until it extended to half an inch from the anus, and the underlying tissues cut through longitudinally backward from the above-mentioned cavity filled with clots, until the subpubic ligament (ligamentum arcuatum, the triangular ligament) could be felt distinctly. No traces of the urethra could be seen among the continually bleeding tissues. A blunt silver probe was introduced in the direction of the membranous portion of the urethra, in the median line, up toward the position where the canal passes through the subpubic ligament, one-quarter of an inch below the inferior limit of the symphysis pubis. After some search in this locality, and after very slight and gentle movements of the probe, the latter finally slid into the bladder and a little urine escaped through the wound. A finger being introduced into the rectum, the probe was found to be in the bladder. On the probe a director was run into the bladder, and now the probe was withdrawn. Along the director a rubber catheter was passed into the bladder, and a quantity of clear urine was removed. Now a curved silver catheter was introduced through the penis int the perineal wound, and from this point, along the director, into the bladder, where it presence was made certain through rectal exploration. The catheter was left in the bladde à permanence, its outer end fastened in the usual way around the pelvis and femora. Th perineal wound was dressed as before. P. M.: Pulse, 112; temperature, 104° F. Morphi and quinin were administered.

August 12th, A. M.: Pulse, 108; temperature, 98⅖° F. The urine passes through th catheter; no swelling in the perineum. P. M.: Pulse, 104; temperature, 103⅖° F.

August 13th, A. M.: Pulse, 92; temperature, 100⅖° F. P. M.: Pulse, 92; temperature, 102⅖° F.

August 14th, A. M.: Pulse, 76; temperature, 101° F. P. M.: Pulse, 80; temperature, 103° F.

August 15th, A. M.: Pulse, 72; temperature, 100¾° F. P. M.: Pulse, 88: temperature, 101° F.

August 16th, A. M.: Pulse, 76; temperature, 98¾° F. The urine is somewhat purulent and alkaline. P. M.: Pulse, 84; temperature, 101° F. The catheter is removed.

August 17th, A. M.: Pulse, 72; temperature, 99½° F. The urine passes without difficulty through the perineal wound, which is now clean and granulating and devoid of swelling. P. M.: Pulse, 84; temperature, 99⅔° F.

August 18th, A. M.: Pulse, 80; temperature, 99¼° F. Introduced soft bougie (No. 13) through the penis, and it issues at the perineal wound, from which it is easily passed into the bladder; copious purulent discharge from the anterior part of the urethra. Injection of sulphate of zinc (1 : 200) every four hours. P. M.: Pulse, 88; temperature, 101° F.

August 19th, A. M.: Pulse, 80; temperature, 99½° F. P. M.: Pulse, 88; temperature, 100° F. Soft bougie (No. 5) passes from the penis into the bladder.

August 20th, A. M.: Pulse, 72; temperature, 98° F. P. M.: Pulse, 72; temperature, 98½° F.

August 21st, A. M.: Pulse, 76; temperature, 98½° F. P. M.: Pulse, 96; temperature, 100° F.

August 22d, A. M.; Pulse, 80; temperature, 98° F. P. M.: Pulse, 80; temperature, 99° F.

August 23d, A. M.: Pulse, 100; temperature, 98½° F. Urine clear and natural, but passes wholly through the perineal wound. A bougie introduced through the penis will not pass into the bladder, but comes out through the perineal wound.

August 24th, A. M.: Pulse, 88; temperature, 98° F.

August 25th, A. M.: Pulse, 72; temperature, 98° F. Catheter à permanence again introduced into the bladder.

August 30th, A. M.: Some pus in the urine; the catheter removed. Afterward he passed some of the urine through the penis.

September 1st: Bougie (No. 6) introduced through the penis passes through the ruptured part into the bladder. P. M.: Pulse, 110; temperature, 103° F.

September 2d, A. M.: Pulse, 96; temperature, 98° F. The greater part of the urine passes through the penis.

September 3d, A. M.: Pulse, 82; temperature, 98° F. P. M.: Pulse, 90; temperature, 98½° F.

September 4th, A. M.: Pulse, 72; temperature, 98° F. All the urine passes through the penis.

September 7th, A. M.: Wound in the perineum healing. He passes No. 8 bougie daily.

September 14th, A. M.: The wound healed entirely. He passes, himself, No. 17 bougie without difficulty.

Discharged recovered, with directions to pass the bougie twice a week.

Etiology and Anatomy.—The varieties of traumatic injuries of the perineum are very limited. Gunshot wounds and wounds produced by sharp or cutting instruments are seldom met with, and are mainly interesting to the surgeon from the accompanying grave injuries to the pelvic organs, and owing to which they are beyond the limits of efficient surgical aid. Almost as rarely do we meet with perineal injuries produced by kicks, either from man or horse. Most commonly are these perineal (urethral) ruptures produced by falling across a rope, as in sailors, or a bar, beam, or joist, as in laborers. If, then, the diameter of the body against which the perineum strikes is less than the distance between the tubera ischii, the danger of crushing injury of the urethra is great, because the soft parts of the perineum, the urethra occupying a central position, are squeezed between the foreign body and the bony pubic arch. In this form of injury it will most invariably be the bulbous portion of the urethra that sustains rupture, on account of the anatomy of the perineal region. Rupture of membranous portion of the urethra is rarely met with unless associated with simultaneous fracture of the pubic arch, the grave consequences of which we are rarely able to prevent. The ruptures of the urethral canal may be complete or incomplete. By complete is meant an entire severance of the whole circumference of the canal, thus rendering the introduction of a catheter into the bladder an impossibility. An incomplete rupture is one in which some portion of the wall, roof, or bottom is left *in situ* along which, with care, a catheter may possibly be passed, sliding along the uninjured part of the canal into the bladder. The refined diagnoses of ruptures of the different layers of the urethral canal,—its mucous, muscular, and fibrous coats,—also further partial or complete ruptures of the whole wall, were first pointed out by Serrillon* and did away with the barbarous distinctions of slight, medium grave, and grave cases of urethral rupture. The experiments on dead bodies published by Poncet and Ollier all go to prove the important rôle that the triangular ligament (ligamentum transversum—Henle) plays in ruptures of the membranous portion of the urethra, the upper wall of which is literally cut through by this ligament. Hence they advise, in introducing a catheter, that the point should be made to traverse the lower part of the wall, this forming a bridge over the rupture and between the anterior and posterior sound portions of the urethra. Confirmatory experiments have not been made, and most surgical authors still believe that rupture of the membranous portion is almost always complicated with fracture of the pelvic bones. Thompson and Cross, after observations on a few cases, are of opinion that ruptures of the urethra may be due to excessive muscular action.

Symptoms and Diagnosis.—An intense pain is experienced in the perineum immediately after the traumatism, followed shortly afterward by swelling in this region from extravasated blood. This swelling is mainly limited to the medial part of the perineum, and gradually becomes harder or more solid from coagulation of the blood, which collects in a variable sized cavity in and around the crushed bulbous portion of the urethra, in and between the second and third layers of the perineal fascia, the limits of which confine the same. Subcutaneous extravasation of blood and consequent ecchymosis, but not associated with marked swelling, will extend from the tumor forward over the scrotum and downward over the femora to a limited extent, accompanied by pain and tenderness, the latter due to direct injury to these parts. The most important and really pathognomonic symptom is bleeding from the urethra. The quantity of blood lost is sometimes considerable, though rarely sufficient to jeopardize life. The inability to pass urine is discovered on the first desire to empty the bladder, and this is usually the symptom that compels the patient to seek medical aid. With the presence of the above-named symptoms, together with the impossibility of catheterization, due to the bleeding resistance in the bulbous portion of the urethra, the surgeon may make certain his diagnosis.

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* Des Ruptures de l'Urethra, Paris, 1878.

Prognosis depends, in the first place, upon our power to prevent the infiltration of urine into the tissues. The first effort of the patient to empty the distended bladder will drive the urine into the blood-filled cavity in the perineum, and hence it will pass into the scrotum, viz., into the loose connective tissue beneath the tunica dartos. From the latter it will spread through the subcutaneous tissue at the radis penis; next along the body of the penis, and lastly, wide-spreading, it will extend over the entire surface of the front of the abdomen. It is unnecessary to state that the manner in which the infiltration proceeds is a simple consequence of the anatomic arrangement of the subcutaneous connective tissue, or fascia superficialis of the above-named regions. The consequence of urinary infiltration is, as is well known, a rapidly progressing phlegmonous and more or less gangrenous inflammation of the infiltrated tissues.

This well-established fact does not correspond with Menzel and Billroth's experiments on animals. These observers found that the subcutaneous injection of fresh healthy and acid urine was absorbed without causing any inflammation of the injected tissues. A phlegmonous inflammation always took place when alkaline urine—alkaline by decomposition from exposure to the air, or alkaline from a bladder in a state of cystitis—was injected into the tissues. We must remember, however, that the fresh healthy urine in our traumatic cases escapes into tissues wounded by contusion and rupture, and into which blood is extravasated, and these tissues consequently being in a state of considerable nervous depression or shock—a depression that alone in some cases will be followed by inflammation. This latter fact is well ascertained from similar lesions in other parts of the body. The phlogotic power of healthy urine, slight as this is, is quite sufficient to cause the readily started inflammation and mortification of these already half-dead tissues.

Increased semi-edematous swelling; spontaneous and continuous pain; dirty-brown discoloration of the tegumentary covering; pulse more or less increased, with elevated temperature, all tend to mark the onset of the secondary inflammation—an inflammation liable to terminate in general sepsis and death. Supposing, however, that proper and timely surgical aid and adequate treatment have carried the patient through this inflammation with tissue-loss only: another serious complication may now present itself on the part of the bladder. A certain number of these patients, not yet statistically determined, will succumb to diphtheric cystitis and consecutive suppurative nephritis. This septic inflammation of the bladder undoubtedly results from an extension of the phlegmonous phlogistic poison along the posterior uninjured portion of the urethra to the wall of the bladder. The danger of this grave complication is evident from the fact that the entire materia medica is almost powerless against its ravages. This variety of cystitis belongs to the great family of septic inflammations, and consequently is preventable only by the most rigorous antiseptic treatment.

The two before-mentioned grave complications either prevented or overcome, the prognosis is good for the time being, as far as the patient's life is concerned. Next must be considered the future function of the urinary organs, and the unavoidable resulting traumatic stricture, due to the contractions of the lately formed connective tissue, the scar or cicatrix replacing the loss of substance in the ruptured urethra. But, of course, this consecutive complication is beyond the limits of our present subject.

Treatment.—The main indications in our treatment of urethral rupture are three, viz.:

1. To prevent the infiltration of urine, or, if this has already taken place, to limit its spread.
2. To reëstablish the free passage of urine through the urethral canal.
3. To prevent the grave consequences of the unavoidable secondary contraction of the cicatrix of the ruptured portion of the urethra, namely, a traumatic stricture.

The above indications are not all liable to be met simultaneously, but each individually is of the utmost importance in the various stages or periods of the disease. For instance, in each one of the three periods the one indication most applicable to this period is of paramount importance, whereas the other two indications must be considered of only secondary value.

First Stage of a Fresh Rupture.—Prevent the infiltration of urine by free evacuation of the contents of the bladder, in one way or another, so as to prevent the urine from infiltrating the ruptured tissues of the perineum. The means of accomplishing this result that surgical literature offers are—(*a*) Catheterization; (*b*) puncture of the bladder, and (*c*) perineal section.

(*a*) *Catheterization.*—In trying to introduce a curved metallic catheter, great care must be exercised in handling the instrument as soon as a resistance in the ruptured portion of the urethra is felt. Try gently to slide the point of the instrument along the upper wall of the canal (in ruptures of the bulbous portion), or along the lower wall (in ruptures of the membranous portion near the triangular ligament), and if we fail, after a short and gentle trial, we must abandon the attempt. One point of importance, however, we shall have ascertained by the metallic instrument, *i. e.*, the exact location of the obstruction.

If we succeed in passing the metallic catheter, which we expect to do in some cases of partial rupture, we now evacuate the urine, to the immediate relief of our patient, and leave the catheter à permanence. In current surgical literature we find the reasonable objection to the catheter à permanence being a metallic one on account of the greater irritation produced to the ruptured tissues than is caused by a soft-rubber instrument, but we would like to see the surgeon, knowing the difficulty of passing a catheter at all in these cases, and having been fortunate to succeed in so doing, who would dare to withdraw it after the evacuation of urine and run the risk of repeating catheterization for the purpose of replacing the metallic for a soft-rubber instrument, to be used as the catheter à permanence. If we have failed, however, to pass a metallic instrument, we next try to pass a soft-rubber English catheter, and if we succeed, we allow this to remain as the catheter à permanence. Thus we have relieved our patient of the immediate distressing pain due to his overdistended bladder, but the question now presents itself, have we at the same time prevented the possibility of extravasation of urine? In most cases probably we have, while in other cases some urine may pass along and outside of the catheter, and thus pass into the rupture. The least increase of swelling or tenderness in and around the injured part will indicate the moment when we will have unhesitatingly to make the perineal section, using the metallic catheter as our guide to cut down upon. After removing the clotted blood, the incision must next be carried into the urethra freely enough to insure the complete escape of the urine from the wound.

(*b*) *Puncture of the Bladder.*—The standard works in surgical literature are still discussing the proper place for the puncture to be made, the choice vacillating between puncture with trocar above the symphysis pubis, or through the rectum behind and above the prostate. The dangers of the former puncture were, up to a recent date, generally considered to be greater than those of the latter. The discussion of this question is needless, since the improvement of the original capillary aspirator of Dieulafoy has placed in our hands a perfectly safe instrument for evacuating an obstructed bladder by this method. Any of the modern aspirators may be used. The position of election is in the median line (linea alba) above the symphysis pubis; there the needle should be introduced into the bladder and the urine withdrawn. We have every reason to confirm the opinion (as far as our experience is concerned) of the first author on ruptures of the urethra, Dr. Orlofsky,* of Warsaw, who has recommended this procedure, and in simple duty to himself we will quote his own words: "I must finally say a few words about the puncture of the bladder above the symphysis pubis by means of the aspirator of Dieulafoy. I cannot recommend strongly enough this little and innocent operation. It relieves the patient of his distress immediately, and is perfectly safe from the grave consequences that otherwise may and actually have taken place after the formerly used method of puncturing the bladder. But it is of value only as a palliative remedy, and is indicated only when, for some reason or other, the radical operation, viz., efficient perineal section (external urethrotomy), cannot immediately be resorted to." We shall again refer, before closing, to the discussion of this latter part of Orlofsky's remarks.

(*c*) *Perineal Section.*—External urethrotomy through the ruptured tissues of the urethra is the first and safest, if not always necessary, procedure, in order to prevent the infiltration of urine. For this reason it is termed by some authors the radical operation. The attempt at introduction of a metallic or soft catheter having been unsuccessful, and the immediate and urgent distress of the patient having been relieved by aspirating the bladder above the symphysis pubis, we can choose our own time, but will have to resort to this operation as the next step in a rational treatment for the prevention of urinary infiltration. We place the anesthetized patient in the same position as for lateral cutting for stone in the bladder. Having procured ample light, and this falling directly upon the perineal region, and with a metallic catheter or a stone probe or conductor, maintained by an assistant in the median line with its point against the urethral obstruction, we make a longitudinal median incision from two to three inches in length, and extending downward upon the end of the catheter or probe. We now remove the blood and coagula from the seat of rupture, and if this be a complete one, severing the whole circumference of the urethral canal, we next try to find the entrance to the posterior part of the urethra. This is generally very difficult to accomplish, owing to the unrecognizable condition of the crushed and bleeding tissues. If we succeed, however, we must introduce a metallic or, better still, a soft catheter à permanence. But if we fail, after a sufficient attempt, we had better not prolong the operation, but now clean the wound, control the hemorrhage, and postpone further search for the urethral opening for the present. We may expect, as is usual in the majority of these cases, that the free perineal incision into the ruptured portion of the urethra will insure the free passage of urine through the wound. At a later period we may successfully pass an instrument (guide, probe, or catheter) into the bladder, guided by the exit of the stream of urine from the wound.

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* Centralbl. f. Chir., 1879, Nos. 14 and 15.

We must still bear in mind, however, that in some cases where we fail to pass an instrument along the posterior part of the urethra into the bladder the retention of urine may persist (as it did in our case), or it may be overcome for a time only, again setting in. In Orlofsky's first case, where the urine passed freely for two days through the perineal wound [illegible] having been passed into the bladder, [illegible] complete return of the retention took [illegible] distress. The next day [illegible] succeeded in finding the entrance to [illegible] by the escape of a few drops of [illegible]. A soft-rubber catheter [illegible] the wound, and from the wound [illegible] and soon into the bladder [illegible]

[illegible] unsuccessful, we continue [illegible]. We may congratulate [illegible] and by its aid we are [illegible] the perineal tissues sub[illegible] the wound, and thus [illegible] the bladder. We do not [illegible] catheter, as in our case [illegible] and proper [illegible] we again repeat [illegible] the ruptured canal. [illegible] successful in [illegible] necessary; next, to cut down toward the triangular ligament, care being taken, of course, not to cut through it, and, guided by the left index-finger held against this ligament, make a careful search with an olive-pointed or blunt probe in the median line, some 5 to 10 cm. below the inferior limit of the symphysis pubis. When the probe, no pressure being applied to it, slides in toward the bladder in the right direction, and almost of itself, the urethra has most probably been found, and the presence of the end of the probe in the bladder may be rendered certain by rectal exploration. A soft catheter can then be easily passed along the penis to the wound, and from the wound along the probe into the bladder, and left here à permanence. It has been and is still considered by some authors that puncture of the bladder is a curative procedure in some cases of incomplete urethral rupture. This result might occur in cases where the obstruction in the canal was mainly due to compression from periurethral extravasation of blood or serum. When this swelling subsides, the urine may pass per vias naturales, and thus perineal section be unnecessary. We deem it dangerous, however, to rest too much faith on this curative power of puncture of the bladder, and rather consider it, with Orlofsky, as merely a very safe and innocent operation for the removal of immediate distress, and only as a palliative procedure, to be replaced by a permanent operation, which insures the complete escape of urine and the certain avoidance of urinary infiltration. Further, we cannot see that any injury to the ultimate function of the urethral tube can result as a consequence of the perineal section itself. After all, the operation can cause only a longitudinal incision through an unhurt portion of the wall of the canal, and the linear scar resulting from this cannot be followed by any remarkable contraction of the canal. The resulting traumatic stricture in these cases of urethral rupture is undoubtedly aggravated but very slightly, if at all, by the effects of perineal section; and even if it were slightly increased, this result is incomparable to the advantages gained by the operation in preventing the otherwise inevitable urinary infiltration, with its subsequent uncontrollable fatal consequence. If, however, urinary infiltration with phlegmonous inflammation has already set in before we see the case, then our line of treatment is the same, only that perineal section is more urgently demanded. Besides this, we must try to arrest the progressive destruction of tissue by free incisions into the infiltrated parts, by drainage, and by washing out the already formed cavities with weak solutions of carbolic acid, thymol (1 : 1000), or saturated solutions of boric acid.

Local applications, cold (France and Germany) or hot (America and England), are of little or no curative value, and if used at all, the choice would depend upon the one that gave the greatest relief from the perineal pain. Prolonged hot baths would be more efficient. Internal treatment, if required, should be merely symptomatic.

Second Stage of the Rupture.—Here the treatment all tends to the reestablishment of the function of micturition. If it were possible to keep the catheter à permanence in the bladder from four to six weeks, or during the time required for the healing up of the perineal wound, the as the lymphatic follicles of the intestinal tract; the tonsils; solitary follicles from Peyer's patches and from the colon, in which a diagnosis based upon histologic grounds could not be made from miliary tubercle. Since Langhans' investigations we have been able to recognize, by the aid of the microscope, the miliary tubercle, even in places and tissues where none of its well-known characters were visible to the naked eye to call our attention to the true nature of the disease.

The unmistakable anatomic characters of the miliary tubercle thus established enabled Köster* to make the most remarkable and unexpected discovery that, in the great majority of the cases of so-called white swelling, tumor albus, caries of joints, chronic destructive inflammation of joints, miliary tubercles were found to be the origin of the disease. Thus the same miliary tuberculosis that in the lungs, brain, and urogenital organs was recognized as an inevitably fatal disease of variable duration, made its appearance in the joints in a disease the prognosis of which as to the life of the patient was not considered grave, provided the proper treatment was resorted to.

It was quite natural that Köster did not believe the facts evident to his own eyes, and expressed the opinion that fungous arthritis (white swelling), in spite of the thousands of miliary tubercles so often found in the various tissues of the affected joint, was a separate disease from the true tuberculosis of the joints, producing or accompanying the fatal and general tuberculosis of the internal organs.

It was now necessary for surgical pathology to engage in the investigation of a question of such vital import, and to sift our knowledge of tuberculosis in general, and especially with reference to its bearing on, and the consequent treatment of, this disease in the joints.

The latest investigators, Volkmann, Friedländer, Schüppel, König, and ourselves, though not numerous, form but one conclusion, and the results of their investigations all tend to confirm the true tuberculous character of the disease in question, and do not admit the distinction of Köster between general tuberculosis and local tuberculosis of joints,—the one benignant, the other fatal,—but rather seem to foreshadow a change in our inherited views of the necessarily fatal prognosis of every disease originating in, or complicated with, the presence of miliary tubercles in the affected tissues.

Numerous future investigations will be required to determine the theoretic as well as the practical importance of the new epoch in the doctrines of tuberculosis. Hoping that surgeons in this country will take their part in the solution of these problems, we will give the pathologic anatomy of the disease, and later point out the main question in its relations to general tuberculosis, and its consequent rational treatment as far as our actual standpoint will permit.

The miliary tubercle shown in Fig. 14 is a small, round tumor not visible to the naked eye. Its main characteristics are as follows: (1) The giant-cell reticulum, forming the central part of the growth and containing one or more giant-cells. (2) The lymphoid reticulum, containing a large number of lymphoid cells, forming the peripheral part of the tubercle and surrounding the former.

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* "Ueber fungöse Gelenkentzündung," Virchow's Archiv, 1869, vol. xlviii, p. 49.

The giant-cell is a large, irregular, and uniformly finely granulated protoplasmic mass (A, Fig. 14), containing a variable number of large, oval nuclei, with one or more nucleoli. The nuclei are either scattered irregularly over the cell mass or are arranged in a row along the peripheral part of the cell. From the surface of the giant-cell pass out long branched processes which are continuous with the reticulum of the central portion of the tubercle.

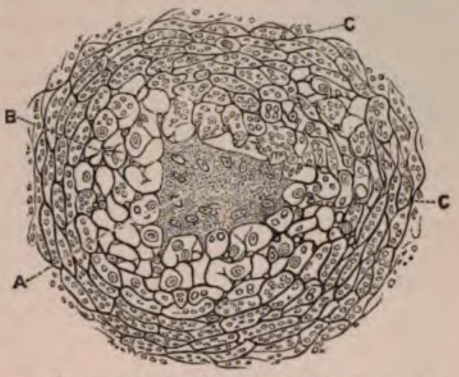

Fig. 14.—Young miliary tubercle in fungous granulations from excision of knee-joint (Fenger): A, Giant-cell; B, giant-cell reticulum with some large epithelial and many small lymphoid cells; C, C, lymphoid reticulum. The wound was mainly healed by first intention, but in circumscribed areas edematous fungous granulations sprang up, and later broke down in circumscribed abscesses. These masses of soft, newly formed tissue were removed with the sharp spoon, and after hardening the same in solution of chromic acid, the tissue shows young miliary tubercles only a few weeks old.

The giant-cell reticulum (Fig. 14, B), forms a network with large round or irregular meshes. Many of the meshes are empty, *i. e.*, do not contain any cells, but are filled up with clear serous fluid. In a few of the meshes are found large epithelial cells with a plainly visible protoplasmic surrounding and a well-defined round or oval nucleus. A large number of the meshes contain two, three, or more small lymphoid cells or nuclei, many of which are highly refracting.

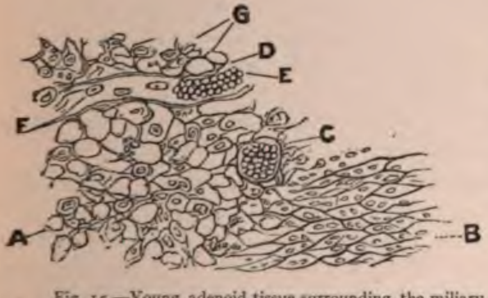

Fig. 15.—Young adenoid tissue surrounding the miliary tubercles, from a case of excision of knee-joint: A, Tissue with large round meshes; B, tissue with oval, narrow meshes; C, transverse section of a small vein filled with blood-corpuscles; D, longitudinal cut of a small vein at E, filled with blood, at F empty, showing the nuclei of the endothelial cells; G, the outer wall of the vessel, forming the reticulum of the interstitial network (framework).

Outside of this giant-cell reticulum we find the peripheral part of the tubercle, consisting of the lymphoid reticulum (C) or small-celled tissue of adenoid-like structure. The meshes of this reticulum are narrow, long, oval, or spindle-shaped spaces, their long diameter being perpendicular to the radius from the center of the tumor. They are filled entirely with innumerable small, round, more or less refracting cells or nuclei.

The surrounding tissue, of recent growth, in which the tubercles are embedded, has, in its young state, invariably all the characteristics of the so-called adenoid or lymphoid structure, as is shown in Fig. 15. It derives its name from its similarity in structure to the lymph-glands or the tonsils, or the adenoid tissue as we find it along the whole of the intestinal tract, or the adenoid vegetations from the nasopharyngeal cavity. It consists of a fine connective-tissue network with round or oval meshes, filled with lymphoid cells and nuclei.

It contains numerous blood-vessels with thin walls, the external coats of which are transformed into or take part in the formation of the branches of the reticulum. This adenoid-like structure of the connective tissue around the tubercles we found in all cases. (The same structure may be found in young connective tissue, the formation of which plays no part in the growth of tubercle.) It grows out between the bundles of the normal tissues,—fibrous, muscular, etc.,—creeps along the vessels into the fatty tissue, and causes thus the thickening of the soft structures of the joints, as we so often find it in the white swelling, where the capsule is transformed into a grayish- white, firm, inelastic, fibrous mass, varying from one to two lines to half an inch or more in thickness.

A transverse section through such a thickened capsule is shown in Fig. 16.

The following are the microscopic features: A, An outer layer of normal fibrillar connective tissue of the fibrous capsule of the knee-joint. Inside of this, at B, two obliquely cut bundles of fibrous tissue, partially transformed into adenomatous tissue. Finally, the thickest inner layer, C, C, consists of adenomatous tissue, with a large number of disseminated miliary tubercles, some of which contain a large giant-cell, E, E, while others, D, D, D, D, have a center consisting of the giant-cell reticulum without giant-cells, but all of them are surrounded by a darker ring of the lymphoid reticulum.

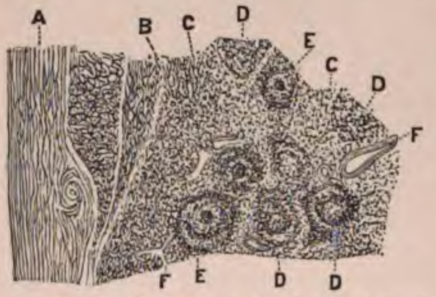

Fig. 16.—Thickened capsule of knee-joint (case of resection of Dr. Fenger): A, Outer layer of normal fibrous tissue; B, bundles of fibrous tissue inlaid with lymphoid tissue; C, C, inner layer of adenoid tissue containing numerous tubercles; D, D, D, D, tubercles without giant-cells; E, E, tubercles with giant-cells; F, F, vessels.

The metamorphoses and alternate fate of the miliary tubercle, as we learn from the most recent authors, are as follows: After an as yet undetermined term of existence, either simple atrophy or fatty degeneration commences in the center of the tubercle, where first the cellular elements and later the interstitial tissue become transformed, partly into irregularly shaped, soft corpuscles,—the so-called tubercular corpuscles,—and partly into a finely granulated fatty detritus.

In rare instances simple atrophy may occur in the cellular elements alone; meanwhile the reticulum gets thickened, and the tubercle becomes transformed into a hard, horny mass. This transformation is considered a cornification, and is only rarely observed.

The partially atrophied and fatty degenerated tubercle will further undergo one of the three following metamorphoses:

Resorption may take place, especially where the tubercles are wide-spread and isolated. Wagner* regards this as a most rare occurrence.

Calcification is more frequent, and means transformation of the fatty detritus into cheesy matter, intermixed with chalky masses, finally encapsulated, viz., surrounded by a capsule of dense cicatricial connective tissue.

Softening and liquefaction are justly considered the most important change, because it is most often accompanied by suppurative inflammation in the surrounding tissue. If the seat of the tubercle is on the surface,—mucous membrane, skin, etc.,—ulcers are formed, and if they are located in the interior of the organs, tuberculous cavities result, and tuberculous abscesses form and often become the starting-point for suppurative processes, *i. e.*, the formation of abscesses around the tuberculous foci.

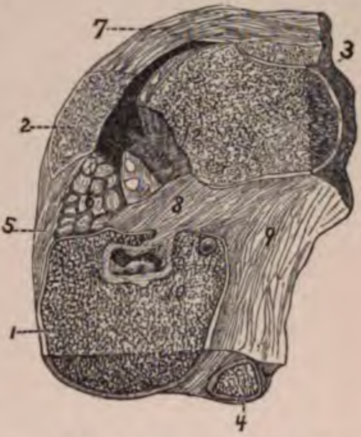

Fig. 17.—Longitudinal cut of right knee-joint: 1, Upper extremity of the tibia. 2, the patella; 3, the lower extremity of the femur, 4, the fibula; 5, the ligamentum patellæ (inferior), with 6, its subjacent adipose tissue; 7, ligamentum patellæ (superior), *i. e.*, the tendon of the quadriceps femoris; 8, the ligamenta cruciata; 9, posterior wall of the capsule with its fibrous ligaments; 10, large tuberculous cavity in the upper end of the tibia, lined with a thick, grayish membrane studded with miliary tubercles and filled with cheesy matter. At the posterior end of the roof is an opening through which the cavity communicates with the joint; 11, a smaller round tuberculous cavity lined with a tuberculous membrane and filled with cheesy matter; 12, a large loss of substance (carious ulcer) in the external condyle of the femur, with several smaller and one large, loose spicule of osseous tissue (sequestra).

Wagner best expresses the general opinion of the profession when he says that the last-named form of fatal transformation of the tubercles is of most frequent occurrence. In the remainder of this paper it will be seen that we do not quite agree with him in this conclusion. We consider, and are obliged to state, that so far as the tuberculosis of joints is concerned, absorption of the tubercles is of frequent occurrence.

A. Primary Osteotuberculosis in the Epiphyses near the Articular Surface of the Bones

The tuberculosis of the joints originates, according to Kocher and Volkmann, in the great majority of cases, not in the capsule or any other of the soft parts, but in the spongy structure of the epiphyseal extremities constituting the joint, *i. e.*, it commences outside the joint as a tuberculous caries, or rather as a local miliary tuberculosis of the epiphyses.

A typical specimen illustrating this fact is shown in Fig. 17.

It represents a longitudinal cut through the knee-joint, removed at a postmortem examination of a patient at the Cook County Hospital.

A short résumé of the records gives the following facts, taken from the history published by Dr. Murphy, of Cook County Hospital, in the Chicago Medical Gazette:

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* Manual of General Pathology, translation, New York, 1876.

Primary osteotuberculosis of the superior extremity of the right tibia. Tuberculous arthritis of right knee-joint. Secondary tuberculosis of inguinal glands, bladder, ureters, right kidney, and peritoneal cavity; commencing chronic tuberculosis of lungs; "pleuritis pyæmica."

Married woman, aged twenty; family history good as to tuberculosis; an aunt died of cancer of the mamma. Five years ago she began to have some dull pain in the right knee-joint; there was occasionally some swelling of the joint, which would last but a few days and then entirely subside, but the pain was a constant annoyance, and seemed to bear no relation to the swelling of the joint. The pain was exaggerated by long standing or walking, but sudden pressure caused her no inconvenience whatever.

Eight months ago, just previous to urinary trouble from the commencing tuberculosis of the bladder, the parts about the joint became much more swollen, the knee was flexed at a right angle, from which position motion caused severe pain. It thus continued very bad for about two months, and then subsided gradually, but remained flexed, though to a less degree. There was no ankylosis, for it allowed quite a latitude of motion. On moving her from her home to the hospital the knee was considerably shaken, which caused an acute swelling of the soft parts. On admission the right knee was found flexed at a right angle, from which position she could move it only to a slight degree. The entire articulation is considerably swollen and tender. The swelling appears to be partly due to a distention of the synovial sac, but also to a general infiltration of the soft tissues of the joint.

There are no sinuses leading into the joint, and no scars resulting from previous abscesses.

For the remainder of the history we shall only state that for the last eight months she had suffered from urinary trouble and pains in the hypogastrium, signs of a chronic, steadily progressing cystitis and pelvic cellulitis, accompanied by loss of strength, anemia, and latterly by fever.

The diagnosis was considered to be a tuberculosis of the organs before mentioned; the prognosis fatal, and death resulted twenty days after admission. The postmortem examination revealed the following:

The right lung contains numerous nodules consisting of peribronchitic granules; in the lower lobe a subpleural abscess about the size of an acorn, containing sanious pus. The left lung contains peribronchitic granules, but no abscesses.

The entire wall of the peritoneal cavity is studded with miliary tubercles; the mesenteric glands greatly enlarged, and mostly degenerated into cheesy matter.

The inguinal glands on the right side enlarged, softened, and broken down into cheesy abscesses.

In the retroperitoneal tissue above the right kidney is a large abscess filled with fluid pus, the walls of which are irregular, ulcerated, and contain numerous miliary tubercles.

The right kidney is filled with miliary and conglomerated tubercles, which in some places are degenerated into large cheesy masses. In the pelvis of the kidney, the walls of the enlarged ureter, and the bladder are found large, confluent tuberculous ulcers, leaving only small islands of recognizable mucous membrane on their walls. The connective tissue in the pelvis minor is infiltrated with tubercles and cheesy matter, in the midst of which are found two tubercular abscesses, one of which opens into the bladder and the other into the vagina.

The right knee-joint is bent almost at right angles, and a little motion is obtainable. The circumference of the joint is somewhat enlarged. The skin covering it is natural. There are no sinuses nor cicatrices and no abscesses around the joint.

The cavity of the joint is filled with whitish, dry, cheesy matter, of the consistence of putty. After the removal of this matter we find the capsule a little thickened and rigid, its inner surface being slightly uneven and velvety, but no miliary tubercles visible.

The cartilaginous covering of the articular ends of the bones is mostly destroyed, and only small, irregular islands of cartilage left on the denuded and roughened osseous surfaces. In the head of the tibia, close to the joint, is seen a cavity (10) occupying the spongy ortion, and measuring 1.5 cm. in anteroposterior diameter, 1 cm. from above down, and cm. laterally. This cavity is lined with a soft, grayish membrane, 1 to 2 mm. in thick- ess. This membrane consists of adenoid tissue, in which are embedded thousands of niliary tubercles. The cavity is filled with whitish, cheesy matter, similar to the cheesy natter found within the joint. Microscopically, this cheesy matter is seen to consist of a inely granulated, fatty mass, with no recognizable cellular elements in it. This tuberculous avity is in communication with the joint in two places: the one at its upper, posterior art, as shown in the figure; the other at the right part of the roof, through the external rticular surface of the tibia. Near the upper posterior margin of the tibia (at 11) is a mall, round cavity of tubercular origin, near the surface of the bone, but not as yet com- nunicating with the joint. In the external condyle of the femur (12) we find a deep trans- erse loss of substance or superficial erosion or carious ulcer, measuring 3 cm. in length, cm. in width, and 4 to 5 mm. in depth. Its walls are irregular, and here and there are arious sized sequestra.

The local osteotuberculosis in the epiphyses, as illustrated in the bove case, is, according to R. Volkmann, the eminent surgeon and athologist and author of an excellent monograph on the diseases in uestion,[*] in the great majority of cases the starting-point of the chronic ungous arthritides, the scrofulous arthritides, and the white swelling f the joints.

The tuberculous osteitis or osteomyelitis in the epiphyses may be ircumscribed or diffuse. Most generally it is local.

Through cheesy degeneration of the tubercles that fill the place of the bsorbed osseous tissue there is formed a cavity filled with cheesy matter, nd lined with a membrane composed of living adenoid tissue and tu- ercles. In a number of cases there will be found variable sized pieces f dead bone or sequestra in those cavities. for the following reasons: First, the tuberculous osteomyelitis cuts off an island of unabsorbed osseous tissue from its nutritive supply, and finally isolates it as a loose sequestrum. Second, a sudden cheesy degeneration and consequent death take place in part of the tubercular, infiltrated, spongy osseous tissue before the absorption of the osseous substance can take place. The portion thus affected must, therefore, at a later period form a loose sequestrum surrounded by cheesy matter and the living tuberculo- denoid membrane.

The cancelous structure surrounding the tuberculous cavity is in ost cases healthy, the miliary tubercles not spreading far into the edullary spaces, but rather keeping together in one circumscribed mor, as we find them in the conglomerated tubercles of the brain, where e thin grayish membrane of miliary tubercles that circumscribes central yellow cheesy mass is surrounded by healthy brain tissue.

This local characteristic of the tuberculosis is a fortunate peculiarity, smuch as it enables us to remove the whole of the diseased part. It ll be sufficient to empty the cavity and scrape out its lining membrane th the curet, sharp spoon, or concave chisel or gouge, for the complete adication of the tubercles of the affected locality. We are thus often able to stop the progress of the disease with a relatively insignificant loss of substance of the epiphysis in question. These primary local tuberculous foci are in some cases single, in others multiple, but the number is generally limited. Usually only one of the bones of the joint is the seat of them, but they may be found simultaneously in two or all of the bones, constituting the joint. Their place of election is close to the articular surface, immediately beneath the articular cartilage, and in children in the neighborhood of the epiphyseal cartilage. A small subchondral primary tubercular focus may disappear in the later destruction of the joint, and thus we are unable to trace, at operation or autopsy, the tuberculous arthritis to its very origin.

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[*] "Ueber den Character und die Bedeutung der fungösen Gelenkentzündungen," ammlung klin. Vorträge, 1879, No. 168, 169.

There are found, however, and fortunately rarely, cases where the tuberculosis is not thus localized, but where the eruption of miliary tubercles spreads diffusely over the epiphyses, resulting in an equally diffuse cheesy degeneration. In such cases the removal of the bone must be much more extensive, thus increasing the danger of operative interference. Volkmann's prognosis in these cases is grave as regards the danger of general tuberculosis, though not necessarily fatal.

In another class of cases, still more rare, a diffuse caseous degeneration takes place throughout the whole of the epiphysis where one or more local tuberculous foci are seated, and on section of the spongy osseous tissue we find it yellow, dry, and bloodless from cheesy degeneration, and dying as a result of the diffuse osteomyelitis of the epiphysis. In these cases removal of the entire bone is demanded.

The local tuberculosis or cavity will slowly grow larger and larger, until finally it will perforate to the surface of the bone. Generally, the disease is not revealed until this event occurs. Symptoms during the stage of development of the cavity, but previous to its perforation, are conspicuous by their absence. There is, as a rule, no pain or disturbance whatever; but as soon as the surface of the bone is reached, the adjoining organs or superimposed tissues become poisoned by contact with the cheesy matter, and inflammation results. Naturally, we might infer that it is a matter of great importance whether the cavity opens within the joint or reaches the bony surface outside the same, and would modify greatly our prognosis as to the result of the disease and the fate of the patient.

If the tuberculous cavity opens outside the joint, the integrity of the latter will remain unimpaired, and extra-articular abscesses will form Sooner or later these abscesses will reach the surface of the part by natural processes or be evacuated by surgical aid. They contain eithe normal pus or a thin, slimy, or scrofulous pus.

The wall of the abscess is lined with a grayish, loosely adherent membrane, and in structure it consists of adenoid tissue, studded with miliary and conglomerated tubercles, often visible to the naked eye a small, round, grayish-white nodules, similar to the tuberculosis of the large serous cavities—peritoneum and pleura—with which we are al familiar.

The fistulous sinuses resulting from these abscesses have little tendency to close up, partly because they communicate with the tuberculous cavity in the bone, and partly on account of the tubercles lining their walls.

The diagnosis of the tuberculous character of the disease can readily be determined by the removal of a portion of the wall by the aid of a curet and examination of the tissue under the microscope.

At this stage of the periarticular tuberculosis proper treatment will, in some cases, arrest further progress of the disease and save the endangered joint. The plan of the operation is obvious. We must cut through the fistulous tract down to the surface of the bone, dilate the osseous opening with chisel or gouge, lay open the tuberculous cavity, remove its contained cheesy matter and sequestra, and scrape or dig away the whole of the tuberculous, infiltrated tissues.

Cases in which the neighboring joint has been saved have been reported by Kocher after the foregoing operation was performed.*

B. THE TUBERCULOUS ARTHRITIS

(1) *The Consecutive or Secondary Tuberculous Synovitis.*—When the osteotuberculous cavity opens into and empties part of its cheesy, infectious contents into the joint, a tuberculous inflammation results. In the great majority of cases this arthritis assumes, from the very beginning, the same chronic character as did the tuberculous caries of the epiphysis. This chronic, slowly developing fungous arthritis has been termed pannous arthritis, from its anatomic resemblance to pannous inflammations of the cornea. The synovial membrane becomes injected and swollen, and the articular cartilages replaced by vascularized granulations or connective tissue. In the cavity of the joint may be found an augmented amount of synovial fluid, somewhat whitish from admixture with lymphoid elements. Slight pain, impaired motion, moderate swelling, no palpable signs of effusion within the joint, and sometimes slight muscular contractions are the symptoms met with in this condition.

This pannous arthritis may set in before caseous matter is effused into the joint (Volkmann and Kocher), from irritation produced by the tuberculous inflammation in such close proximity to the articular surfaces. As the pannous arthritis has a tendency to obliterate the cavity of the joint and to terminate in a more or less complete false ankylosis, it often happens, therefore, that the caseous matter opens into an already partially obliterated synovial cavity. If this be the case, the reactionary inflammation will be far less vehement than if the cheesy matter entered a normal-sized and healthy synovial cavity.

The foregoing reasons account for the well-known fact that the fungous arthritis sometimes sets in with the symptoms of an acute inflammation; generally, however, it has a chronic character from the start. This chronicity may be interrupted by acute but transient exacerbations, to be accounted for by the cheesy matter as above stated.

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* "Zur Prophylaxis der fungösen Gelenkentzündung," Volkmann's klin. Vorträge, No. 102.

The most serious consequence of this tuberculous arthritis is its destructive influence on the integrity of the affected joint. The articular cartilage or the periosteum disappears or is transformed into miliary tuberculous adenoid tissue, and the epiphyseal arthritis of the bones becomes destroyed by a carious tuberculous osteitis, extending from the surface to the deeper tissues of the bone.

The secondary tuberculous destruction of the epiphysis is sometimes uniformly distributed over the entire articular surface, while in other cases it is localized and forms shallow excavations. A specimen representing the latter condition is shown in Fig. 18.

This upper extremity of the right femur, removed by excision by Dr. E. W. Lee, shows, besides considerable superficial destruction of the head (4), a shallow cavity (5), 2 cm. long, 1½ cm. broad, and ½ cm. in depth, situated in the inferior portion of the neck and also in the head of the bone. This cavity is mainly filled with a mass of reddish-gray, soft tissue (6),—fungous granulations,—in which fine yellow specks or points are seen, but no gray miliary nodules are visible to the naked eye. The microscopic examination of this tissue shows it to consist of adenoid tissue and miliary tubercles.

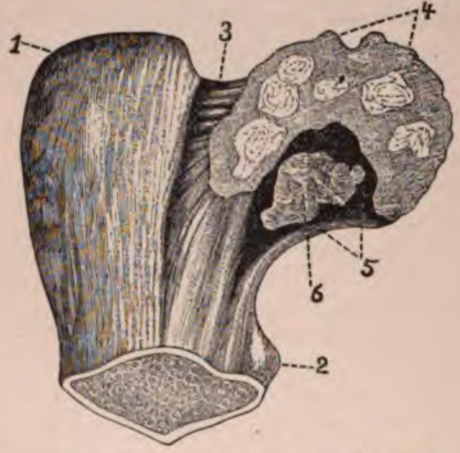

Fig. 18.—Upper extremity of the right femur removed by excision by Dr. E. W. Lee, from a six-year-old girl suffering from morbus coxarius with a large anterior abscess: 1, The great trochanter; 2, the lesser trochanter; 3, the neck of the femur; 4, the head of the femur reduced to one-third its normal size, with irregular circumference and denuded roughened surface; 5, tuberculous cavity in the head and neck, partially filled with 6, a mass of reddish-gray, soft tissue—fungoid granulations—consisting of adenoid tissue with miliary tubercles.

In this secondary diffuse and superficial tuberculosis of the bones—tuberculous periostitis, osteitis, and caries—the osseous tissue is transformed into masses of reddish-gray, soft tissue, viz., fungous granulations; hence we find in this tissue, situated between the adenoid tissue and the tubercles, spicules of bone undergoing the process of absorption.

In Fig. 19 is shown a section of fungous granulations covering the atrophied anterior surface of the lower extremity of the humerus. This was removed by excision of the elbow-joint in a case of chronic fungous arthritis in Dr. Lee's practice. We find a young connective tissue, rich in cells and mainly adenoid in character (1), containing a number of variable-sized round, empty spaces, with serous fluid filling the large lymph-spaces, 2, 2, 2, 2, 2. At 3 is a miliary tubercle with a giant-cell (4) in its center, and at 5 is an irregular island of osseous tissue (spicule), with bone-corpuscles surrounded partly by lymph-spaces and partly by adenoid tissue.

This little spicule of osseous tissue is part of the old bone in the stage of absorption, because in no part of its surface are found either osteoblasts or connective tissue—corpuscles or cells undergoing the process of transformation into bone-corpuscles.

The effect of cheesy matter from a tuberculous cavity upon the healthy synovial cavity has been demonstrated by the experiments of Professor Hueter,* of Greifswald.

He made an emulsion of tuberculous sputa from consumptive patients, and then injected one-third to three-quarters of the contents of a common subcutaneous syringe into the cavities of the knee- and ankle-joints of five dogs. After eight to fourteen days swelling commenced in the joint, abscesses reached the surface and left sinus openings, discharging a seropurulent fluid. The animals became emaciated, and diarrhea set in. One of the dogs died of acute general miliary tuberculosis. When the inflammation of the joint subsided, the general condition of the animals improved, he also noticed. In the joints of the animals which he killed was constantly found a condition of fungous arthritis in different stages. The fungous granulations of such a joint were emulsionized with water and injected into the peritoneal cavity in two healthy dogs. Four weeks later the animals were killed, and he found swelling of the retroperitoneal glands, desquamative pneumonia in the lungs,—consumption,—miliary tubercles in the diaphragm and the pleural cavities. He, therefore, concluded that the fungous arthritis—the synovitis granulosa—is a tuberculous disease.

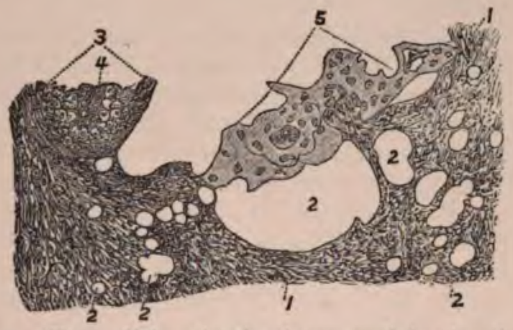

Fig. 19.—Miliary tuberculous fungous granulations from elbow-joint. Excision by Dr. Lee for chronic fungous arthritis with impending ankylosis. No periarticular abscesses nor fistulas. Old primary osteotuberculous cavity in the head of the radius. Secondary superficial tuberculosis of the olecranon and the lower extremity of the humerus; 1, Young connective tissue of mainly adenoid character, with 2, 2, 2, 2, 2, smaller and larger lymph-spacees; 3, half of miliary tubercle with the giant-cell, 4, in the center; 5, spicule of osseous tissue.

(2) *The Primary Tuberculous Synovitis.*—*A priori*, there is no reason why the tuberculosis should not commence in the synovial membrane of a joint as well as in the adjoining bones, but *a priori* theories or reasonings are of little account when compared with observations based upon facts. The numerous authentic cases upon which Volkmann founded his monograph made him enunciate the opinion that the synovial tuberculosis in the great majority of cases is secondary—caused by a communication being established between the primary osteotuberculous cavity

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* "Die experimentelle Erzeugung der Synovitis granulosa an Hunde, und die Beziehungen dieser Gelenkentzündung zur Tuberculose." Deut. Zeitschr. f. Chir., 1879, vol. xi, p. 317; Centralbl. f. Chir., 1879, vol. vi, p. 706.

and the joint. We do not doubt but that his statement is in strict accord with the facts observed by him.

Volkmann admits that primary synovial tuberculosis is a rare event, and thus far we agree with him; but when he further states that primary synovial tuberculosis occurs rarely save in adults, and calls for a much more serious prognosis than the common secondary tuberculous arthritis, we beg leave to differ with him.

In one of our cases, where, in tuberculosis of the knee-joint, excision was performed by Dr. Fenger, there was no primary osteotubercular focus to be found in any part of the bones.

In the hip-joint represented in Fig. 18 we feel inclined to regard the tuberculosis of the neck and head of the femur as secondary on account of the shallowness of the cavity, but we admit that our opinion here might be disputed. An important step toward the solution of this problem has been made by the recent experiments of Shüller.*

The author, being aware of the clinical fact that a slight trauma was often mentioned as a common factor in the etiology of the scrofulous, viz., tuberculous inflammations of the joints, desired to settle the following queries: Why can such an unimportant traumatism—in children, almost of daily occurrence—produce, in a very limited number of individuals, such serious consequences? and what are the predisposing morbid conditions in the organism of the individual subject to such grave results? Clinical observations have long since pointed out the coincidence, to say the least, between fungous arthritis, scrofulosis, and tuberculosis. Villemin had produced tuberculosis by inoculation; Tappener, by inhalation of tuberculous and scrofulous cheesy matter. Schüppel had found miliary tubercles in the caseous, so-called scrofulous lymph-glands. The latter sometimes suppurate, and periglandular abscesses form; these, as well as the chronic, cold, or scrofulous abscesses, contain in the lining membrane of the wall thousands of miliary tubercles (Volkmann). Scrofulous ulcers of the skin, so common in children, grave cases of scrofulous ozena, a number of anal fistulas, obstinate ulcers of the soft palate and the pharynx in children and young individuals, where the malignancy of the ulcers was attributed to hereditary syphilis or their lupoid character, show, according to Volkmann's investigations, that miliary tubercles are the cause of their local destructive tendency.

The identity of scrofulosis and tuberculosis was slowly approaching the condition of an established fact. The above-named investigation caused Schüller to enter the experimental field relating to fungous inflammations of the joints.

Rabbits and dogs were infected with tuberculosis, viz., scrofulosis in the following way:

(*a*) Tuberculous sputum from consumptive patients, or an emulsion of cheesy matter and miliary tuberculous tissue from human lungs, was injected by means of a hypodermic syringe, the point of which was pushed through the thoracic walls.

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* Centralbl. f. Chir., 1878, vol. v, p. 713, and 1879, vol. vi, p. 305.

(*b*) The same kind of emulsion was injected into the trachea through the wound of a preceding tracheotomy.

(*c*) By means of an atomizer the same emulsion was thrown into a closed space containing animals.

Besides the emulsion of tuberculous sputa and caseous and tuberculous tissue from the lungs, the author used for the infection of the animals a fluid containing secondary generations of micrococci, contained in the above-named material. The cultivation of these micrococci was produced in the following way: Miliary tuberculous lung tissue or cheesy matter from scrofulous glands was ground in a mortar in Bergmann's fluid for cultivating bacteria, thus forming an emulsion. Bergmann's fluid consists of 100 c.c. of distilled water; 10 grams of rock-candy; 1 gram of tartrate of ammonia; and ½ gram of phosphate of potassium.

The emulsion is then filtered, and of this milky filtrate from one to three drops are put into cleansed glasses containing Bergmann's fluid. The glass is kept at a temperature of 30° C., and after three to four days the fluid becomes cloudy or milky from generated micrococci, and the so-called first culture or generation is completed. One to three drops of this is mixed in another glass of Bergmann's fluid, and results in three to four days in the second culture or generation. In the same way a third generation is produced from the second.

The fluid contains a multitude of small, round bacteria in very rapid motion. At 450 diameters they are to be seen as small round points. At 800 to 1200 diameters, and colored with methyl-violet, they can be distinctly seen as spheroid bodies, isolated or in groups of two or three. The second generation contained only these bacteria in a fluid free from the cells or particles of the original tubercles or cheesy matter. This fluid was then used for injection into the lungs or for inhalation with the same effect as the original emulsion of tuberculous tissue and cheesy matter. Rabbits and dogs were used for the experiments. The dogs and the larger and more powerful rabbits tolerated the operation readily, and the tracheotomy wound healed up without accident. The infected animals after some time would commence to lose weight and become emaciated, and in spite of their good appetite would die in the course of three to ten weeks from tuberculosis of the lungs and other internal organs.

Traumatic lesions were now produced upon the joints of the infected animals. In the great majority of them the result was a chronic fungous arthritis, a tumor albus, a pannous arthritis.

The synovial membrane became thickened and covered with granulations (these granulations will also cover the peripheral portions of the cartilages), the cartilages thickened and became opaque, vascular, and finally transformed into the same kind of granulation tissue as is found on the synovial membrane. The epiphyses of the joint became thickened and osteoporotic, but no central carious cavity filled with cheesy matter was found in them. Toward the surface, however, in the enlarged medullary spaces, was found an infiltration of lymphoid cells and consequent fatty degeneration. In and around those spaces miliary tubercles were constantly found. In the granulation tissue, in and on the synovial membrane, miliary tubercles were found now and then, but fewer in number and less frequently than in the medullary osseous tissue. Thus it was proved that a fungous arthritis of tuberculous character, a tuberculous synovitis commencing in the synovial membrane, was the result of slight traumatism in animals infected with the tuberculous poison.

Deciding experiments were made in which the same traumatisms to the joints of non-infected animals were produced, and were not followed by any such chronic inflammation. A slight serous effusion or even extravasation of blood in and around the joint became absorbed in a few days, leaving the joint as healthy and movable as before.

The above experiments, together with the observed clinical cases where no primary local osteotuberculosis is found after operation, tend to justify the opinion that a *primary tuberculous synovitis exists, not as a rare and grave disease, as Volkmann believed, but as one of the common forms of fungous arthritis,* that we so frequently meet with, resulting from slight traumatisms to the joints in scrofulous, *i. e.*, tuberculous individuals—mostly in children.

This primary tuberculous synovitis can further be a local tuberculosis as well as the osteotuberculosis of the epiphyses, as we have seen in our case of excision of the knee-joint, where the recovery is complete and the patient is growing stronger and gaining in weight, and not exhibiting the faintest signs of tuberculosis in any other organs of the body.

The relative frequency of the primary and secondary tuberculous arthritis must remain an open question at present, and will have to be determined by further clinical observations.

The practical bearing of the question is this: If the tuberculous arthritis, as Volkmann believes, is almost always secondary to a primary osteotuberculosis, we might hope, in a large number of cases, to be able to destroy the disease by local treatment previous to the extension of the disease to the joint. Successful cases of this kind are reported by Kocher and Volkmann, but up to a recent date their number was only small, and we must regard them as exceptional cases.

COURSE AND TERMINATIONS OF TUBERCULOUS ARTHRITIS

The object of this paper being only, or mainly, to elucidate and demonstrate the pathology of tuberculosis of the joints, we will have to postpone the discussion of the details of the course, viz., symptoms, complications, etc., until a future occasion, when symptoms, treatment, and its results will be illustrated by authentic cases of the disease. In this paper, however, we shall only point out some of the main indications on general principles.

At present we know not what proportion of the cases of tumor albus, white swellings, or fungous arthritides are complicated with or dependent upon a miliary tuberculosis of the affected joints. Future investigations will have to solve the question: Are tubercles present in every case of fungous arthritis, or, in other words, is every case of fungous arthritis a local tuberculosis? or, still further, do there exist two distinct classes of fungous arthritis, one tuberculous, and the other non-tuberculous? From a pathologic point of view this question is of vital importance as far as the prognosis is concerned, because a non-tubercular arthritis would be a benignant disease, not for the joint, but for the life of the patient, as there would be no danger of a general tuberculosis resulting therefrom. The investigations of Volkmann and Friedländer during the last years seem to prove that the great majority of the fungous arthritides are of a true miliary tuberculous nature. If this be the true state of things, we shall have to change our inherited views of the malignancy of the miliary tuberculosis, and we shall have to admit that a local tuberculosis of a bone or a joint is so far benignant that it may terminate in a relative recovery, viz., in ankylosis of the joint without the necessity of involving a fatal general tuberculosis of the lungs or any other system of organs necessary for the continuation of life.

It is now beyond doubt that a number of tuberculous arthritides terminate in what we used to call recovery, that is, a more or less complete fibrous or osseous ankylosis of the affected joint. It is further possible that this recovery may be a complete one as to the tuberculosis, viz., that all the tubercles in the fungous arthritis have disappeared, and the tissues of the ankylosis consist of fibrous and osseous tissue apt to persist for an indefinite period of years without any danger, either from future local inflammation or from general tuberculosis.

A very interesting point in Schüller's experiments we wish to mention in connection with this side of the question. Consequent to the experiments with the bacteria developed in Bergmann's fluid, Schüller raised the question whether or not antidotes of antibacterial remedies would not show a beneficial influence upon the tuberculous infected animals. He pretends to have found that inhalations of a 5 per cent. watery solution of benzoate of soda, thrown into the respiratory tract by means of atomizers, was effective, sometimes curing and always ameliorating the condition of the tuberculous animals. Under this treatment they gained in weight, the tuberculous arthritis got better, and, if not too far gone, disappeared entirely.

How common this complete recovery is we do not know at present. But we shall here point out and demonstrate the fact that the recovery from a tuberculous arthritis may seem complete for years and still hide the germ of a finally fatal tuberculosis.

Fig. 20 shows an ankylosed hip-joint, removed at a postmortem examination of a man about thirty-five years old, who died in the Cook County Hospital from chronic pulmonary tuberculosis, *i. e.*, consumption. The patient, when about fifteen years old, had suffered from morbus coxarius which had terminated in an ankylosis and left him a relatively useful limb, on which he was able, in spite of the false position,—flexion almost to a right angle with the perpendicular line of the body,—to walk or limp around for a good many years. We find, as is shown in the cut, a tuberculous abscess filled with cheesy matter, situated on the pelvic surface of the corpus ossis ischii.

This abscess communicates with two osteotuberculous cavities—the upper one in the acetabular portion of the os ischii, the other in the atrophic head of the ankylosed os femoris. Still lower in the head of the femur is another small, round, tuberculous cavity (13) that has no communication with the above-described ones. This local tuberculosis of the hip-joint and its surrounding bones was the primary disease. The arthritis terminated in an ankylosis. The tuberculous cavities, filled with cheesy matter and lined with a membrane containing thousands of miliary tubercles, remained for a long series of years harmless, but

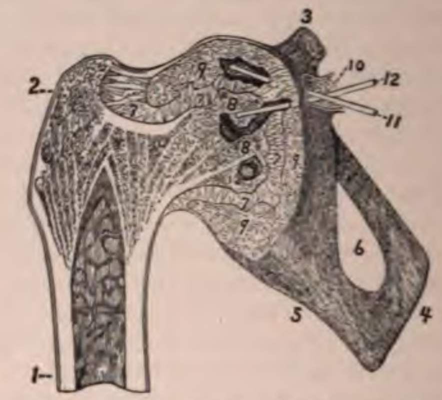

Fig. 20.—Ankylosed hip-joint. The femur in a degree of flexion, forming a right angle 90 degrees with the perpendicular axis of the body: 1, Shaft of femur; 2, the trochanter major; 3, the spina ossis ischii; 4, the symphysis ossis pubis; 5, the ramus horizontalis ossis pubis; 6, the foramen obturatorium; 7, 7, 7, 7, firm fibrous tissue filling up the former cavity of the joint, uniting 8, 8, the remnant of the atrophic head of the femur with 9, 9, 9, the bony walls of the irregularly excavated cavity of the acetabulum; 10, tuberculous abscess, viz., cavity filled with cheesy matter on the inside of the os ischii in the cavity of the pelvis minor; 11, probe leading through this abscess into a tuberculous cavity in the os ischii on the inside of the former acetabulum; 12, probe leading through the abscess into a tuberculous cavity in the ankylosed head of the femur; 13, isolated miliary tuberculous abscess or focus in the head of the femur.

finally were the source of an infection from which emanated the fatal tuberculosis of the lungs.

The tuberculous cavities in the bones, in these cases, and the tuberculous abscesses around the bones, keep the patient in constant danger of a general tuberculosis in the vital organs of the body. How long a period—how many years—the local tuberculosis will remain latent we do not know. Neither do we know the circumstances or causes under which the tuberculous poison from those hitherto quiet foci spreads out from its local seat into the organism, and causes either an acute miliary tuberculous meningitis of the base of the brain, an acute miliary tuberculosis of the lungs, or a chronic tuberculosis of lungs, genito-urinary organs, peritoneum, etc.

We now very naturally have to ask the question: Will this new light thrown upon the cause and nature of fungous arthritis have any influence on the treatment? Will we have in the future to operate on cases in which we before trusted to an expectant and less bloody means of cure? We must answer the question in the affirmative, but at the same time warn against an unlimited cutting away, regardless of results, of every particle of tuberculous tissue of the local tuberculosis, in view of avoiding a fatal generalization as unnecessary and not indicated. It certainly was for many years a *pium desideratum* to be able to cut away old cheesy deposits in lungs and bronchial glands, as the pathologist saw in numerous cases the deadly general tuberculosis start out from these very places. In later years this desideratum, to prevent general infection, was partly realized by removal* of cheesy glands from the neck and scraping out of scrofulous ulcers with the sharp spoon. But, as we learned to know the true tuberculous character of a great many of the so-called scrofulous inflammations, cheesy glands, sores, and fistulas, some varieties of lupus, we were obliged to give up part of our inherited dread of miliary tubercles, knowing that a number of the last-named local tuberculoses heal up without operation and without being followed by fatal general tuberculosis.

The still considerable number of cases where the local tuberculosis leads to a fatal generalization compels us to operate where the removal can be effected without danger to the life or any considerable destruction of the part affected.

The frequency of a primary osteotuberculosis as the cause of the fungous arthritis demands a minute and constant watching of the initial stage of the disease, and as soon as we may be able to make the diagnosis of the affected locality of the bone, we will have to proceed to its removal by gouge, trephine, and curet, etc., or its destruction by red-hot iron (Kocher). It is completely useless in these cases to lose time by relying on the application of external remedies, even down to actual cauterization, though the whole thickness of skin and subcutaneous tissue be destroyed by the same. They will have no effect at all upon the local tuberculosis in the interior of the bone, and this will proceed undisturbed on its way toward the destruction of the joint.

Further, we shall have to make a change in the old indications for resections—excisions—of the joints. The majority of surgeons have been used to make the excisions late—often too late—in the course of the disease. We were accustomed to require discharging fistulas, or palpable periarticular abscesses, besides crepitation on motion of the joint, which latter means a carious destruction of the articular surfaces. Now we find in a number of cases of extensive tuberculous destruction of the epiphyses and fungous destruction of the synovial membrane no fistulas, no abscesses, no crepitation on moving the joint, and, nevertheless, the excision strongly indicated, as shown by the records of the knee case (Fig. 17) which we have before mentioned. In a case at Cook County Hospital, where a successful excision of the knee-joint was performed by Dr. Isham, there were no fistulas, no abscesses, and only slight swelling of the joint.

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* Hüter: "Die Scrofulosis und ihre locale Behandlung als Prophylaxe gegenüber der Tuberculose," Volkmann's klin. Vorträge, Chirurgie, No. 15.

The boy had for years been unable to use the limb on account of pain in the joint. There were some angular deviation outward and some lateral mobility, owing to destruction of the internal lateral ligament. The exsection revealed, besides a fungous arthritis with partial destruction of the articular cartilaginous surfaces, a tuberculous cavity filled with cheesy matter in the upper epiphysis of the tibia, extending down below the cut surface of the latter. The exsection, combined with évidement of the lower part of the cavity and drainage through a drilled opening through the anterior surface of the epiphysis, effected a complete recovery, viz., an ankylosis with a useful limb.

As we have already pointed out, we must leave the details of indications for operation, and details of symptoms and course for future clinical records of cases, which will be published as a continuation of our present paper. We shall here mention only the two main points for consideration before we resort to excision of a joint.

The first is, we require as the probable result of the operation a more useful limb for the patient than he had before the excision, or probably would have within a reasonable time without surgical interference.

The second: we insist and expect, in removing the tuberculous joint, to free the patient from an everexisting source for general tuberculosis—a sword of Damocles hanging over and constantly menacing his very life.

The larger the quantity of cheesy matter, the less the possibility of a speedy absorption of this infectious substance, the greater will be the importance of the second point as an indication for operative interference.

But the whole modern tendency toward conservatism in surgery demands that the question of general tuberculosis be put second to the question of the function of the joint or the limb. In deciding otherwise we would run a risk for an uncertain gain, the percentage of which is as yet not known, in operating on cases where non-interference would give as good results with less, or without temporary, danger to the life of the patient. Future observations will have to determine the relative weight of these two main factors in the indications for operative interference.

It will be only through numerous carefully observed cases that future surgery will be able to decide upon the best course of procedure in each single instance of the disease in question.

RCULOSIS OF JOINTS, WITH THREE CASES OF EXCISION*

WITH E. W. LEE, M.D.

ssion of the subject of exsections of the knee-joint which
idged from a clinical lecture delivered in Cook County
re the operation was made.

of the knee-joint is generally considered a serious, not to
, operation. We shall now first consider this point; then
in general and in this case; and, finally, the methods of
ch this case is intended to illustrate.

nger to the life of the patient we must seek information in

thered by König † is as follows:

	Good Result.	*Failure.*	*Mortality.*
....	44 per cent.	56 per cent.	33 per cent.
....	62 "	38 "	28 "
en and adults) ..	60 "	39 "	30 "
)...............	44 "	56 "	39 "
....	56 "	43 "	27 "
....	62 "	37 "	19 "

istics were gathered about 1870, and show a mortality of
cent. This is the death-rate of the statistics of Pénières,‡
431 cases of excision of knee-joint for white swelling 131
, 30 per cent.

lish surgeons, however, we have smaller series of operations,
r results.

reports in an old series...............	31 cases	with	11	deaths.
series..............................	20 "	"	5	"
reports............................	39 "	"	6	"
rts................................	19 "	"	2	"

ring the value of the statistics there are two interesting

e of the patient has great influence on the death-rate, as
ières:

ge.	*Death-rate.*
o 5 years....................................	38.8 per cent.
o 10 "	15 "
o 15 "	18.9 "
o 20 "	32.7 "
o 25 "	35.7 "
o 30 "	37 "
o 40 "	45 "

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ed. Jour. and Examiner, 1880, vol. xli, p. 7

zur Resectionen des Kniegelenkes," Langenbeck's Archiv, 1867, Bd. ix, p.
, "Optegnelser of praktisk Lägekunst," Hospitalstidende, 1872.

ons de genoux, Paris, 1869.

In one series of Pénières were 30 excisions in children from nine to eleven years without a death. The death-rate is lowest, therefore, in children from five to about twenty, and the danger as the age advances gradually increases.

2. The period in which the operation was performed is next in importance, insomuch that we find the death-rate from the early days of this operation by surgeons to a recent date to be steadily decreasing. Pénières gives the following statistics on this point:

From	1762 to 1830	there were	11	excisions,	6	deaths	......54.5	per cent.
"	1838 to 1850	"	21	"	11	"	......52.3	"
"	1850 to 1860	"	246	"	73	"	27	"
"	1860 to 1869	"	155	"	42	"	27	"

Better methods of operating, better after-treatment, and better knowledge of the indications for the operation may account for this decrease in death-rate. But even in 1873 the average death-rate was not below 27 per cent. Exceptions were Fergusson's second series, 25 per cent.; Humphrey's series, 15 per cent.; and Jones' series, 10.6 per cent.

In Germany up to this time (in 1873) the death-rate is considered by Volkmann to be about 50 per cent.* Very naturally, therefore, Volkmann preferred the expectant treatment in white swellings of the knee-joints in the absence of fever and wasting discharges that threaten the life of the patient.

The next and latest important step toward a more favorable result for this operation is Lister's method of operating and dressing.

In 1872 Holmer, of Copenhagen, made four excisions for white swelling, with three good results, one secondary amputation, and no deaths.

In 1875, 1876, and 1877 Volkmann made 32 excisions for the disease, with no deaths from the operation. One patient died several weeks later of tubercular meningitis.

It is now impossible to know the exact danger to life from this operation. We cannot expect to reduce the death-rate to zero by antiseptic methods, for that would be perfection. We can only hope to come nearer and nearer the ideals without ever reaching them. But the latest statistics from other fields of operative surgery give us the right to expect that excision of the knee-joint will henceforward be an operation devoid of very great danger, whenever all its details and after-treatment are performed with strict antiseptic precautions. But the surgeon must have patience to attend to all the little details of the antiseptic method, on each of which the life of a patient may depend.

The object of excision of the knee-joint is obvious. It is to save a limb that otherwise must be lost sooner or later by amputation, this latter operation being finally required in cases where recovery is hopeless by abatement of the inflammation or by such firm ankylosis in a false position as will not give the patient a useful limb.

* R. Volkmann: "Die Resectionen der Gelenke," Sammlung klin. Vorträge, 1873, No. 51, p. 291.

By this operation we create a firm ankylosis which the patient can use continuously without pain or fatigue.

The question now is, can we accomplish this purpose of the operation without months of confinement and suffering in bed for the patient, with such abundant suppuration as would endanger his life from exhaustion, amyloid degeneration of the kidneys, liver, and spleen, even if he should escape pyemia?

From Hodges' statistics, Gant puts the average time of after-treatment at eight months. This is a long time if the patient must remain in bed and sustain a constant suppuration.

Fortunately, this is not the case. As soon as a solid osseous union has taken place between the cut ends of the femur and tibia, we may allow the patient to be about on crutches. Fergusson has had patients up in this way in three to six weeks after the operation; but such cases are regarded as fortunate exceptions. Holmer had his patients up and on crutches after three or four months.

Under the Lister dressing suppuration is sometimes reduced to a mere trifle, generally to a moderate amount; so there is no danger from exhaustion.

If, then, the patient can expect to be up after an average of three months, and be sure of a useful limb after another three or six months, he is far better off than he could be without the operation.

Tuberculosis of the knee-joint. Excision by Dr. Ch. Fenger.

James C., aged fifteen years, clerk (in chair factory), entered Cook County Hospital July 15, 1879. None of his relations have suffered from consumption or cancer. Had measles and typhoid fever in childhood; always healthy since. Two years ago he received a kick from a playfellow upon his left knee. Pain disappeared in a few days and there was no swelling. Three or four months later the knee-joint began slowly to swell and be occasionally painful, and motion became gradually impaired. The joint felt to him stiff. The knee remained in this condition about six months, during which time he could walk, run, and jump without much pain. Then one day, when jumping, he suddenly felt severe pain in the joint, and he was obliged to sit down two hours. The pain gradually subsided, and soon he was able to run about again for a short time. But gradually the swelling increased, pain came on, and he got easily tired.

About a year ago abscesses formed and opened on the outer and inner sides of the joint, near the hamstring tendons. Fistulas were left which discharged six months; they closed, to break open later again and again close up. No spicules of bone were discharged to his knowledge.

Contracture now came on, and the leg was at last flexed at nearly a right angle, and motion was limited to 20 degrees. In spite of this condition he could, most of the time, hobble about, bearing some weight on the leg; but the leg easily tired, and on stepping upon an uneven surface or jarring the knee, pain was produced. He is constantly afraid to have any one come near the limb for fear of hurting it.

On July 3d (twelve days ago), while at work, a sudden pain came on and the knee got worse. Now any considerable motion causes pain. In perfect quiet pain is absent. As to previous treatment, he says at one time a doctor tried to aspirate the joint, getting no fluid. Another time a blister was applied over the joint, with the effect of ameliorating the condition.

He is now slender, pale, and lean. The heart, lungs, and abdominal organs are healthy. The urine has no sugar or albumin. The left knee is enlarged, forming a prominent round tumor. The joint is flexed to about 110 degrees, and motion is allowed of only 10 degrees; attempts to increase the range of this causes pain.

The relative position of the crus to the thigh at the joint is that of genu varum—knock-knee. This means a partial dislocation, due to weakening or partial destruction of the internal lateral ligaments. On the sides of the joint are depressed reddish spots, the seats of the closed sinuses. The patella is immovably fixed to the fossa of the condyles of the femur. The swollen soft tissues form a uniform, softish, somewhat elastic mass, like india-rubber of medium hardness. There is no fluctuation or other evidence of fluid in the capsule or outside the joint. Pressure upon the mass does not cause pain, except at two points on the sides corresponding to the spaces between the joint surfaces covered by the lateral ligaments.

We have here a chronic fungous arthritis or white swelling.

The constituents of the joint are already partially destroyed, as prove the adherent patella and weakened internal ligaments and the partial ankylosis, *i. e.*, the impaired motion.

We have now to ask what would be the result of this case without operation.

The destructive inflammation here has been slowly progressing; motion has grown less and less, partly from tenderness and pain, partly from false position. We have for the three weeks he has been in the hospital tried gradual extension (by weight and pulleys) to correct the flexion, and hot fomentations for the pain. The treatment has not had the slightest effect. We then have left the choice between forcible extension of the joint under anesthesia, and immobilization with plaster-of-Paris or starch, and excision.

The liability of the inflammation at the bottom of the old sinuses to be lighted up anew speaks against immobilizing bandages. They would have to be removed at intervals. This would make recovery by ankylosis in good position unlikely to occur. This treatment would probably be interrupted by abscesses that might extend up and down between the muscles and make amputation necessary, and excision, if it was to be made, much more uncertain of a good result.

The age of the patient is in favor of excision, and a solid union of the bones with diseased soft parts removed is decidedly preferable to a more or less complete ankylosis with diseased tissues remaining between and around the epiphysis of the bones, because in this case there would always be a liability to a relapse of the inflammation.

Excision being then decided on, the next question is the plan of operating.

1. Esmarch's bandage for operating without blood-shed should be used when there is no danger of pressing pus or infectious thrombi of the veins up into the healthy soft parts above the seat of operation. As there are no abscesses and no edema, we shall use it here. Besides avoiding blood-loss, this method enables us to distinguish the character of tissues with much more exactitude than we could without it. It is not only consistence but color that indicates what tissues are to be removed and what not. The well-known light yellowish-gray color of cheesy

matter means fatty degeneration of the tissue—that it is dead or dying and must be removed.

2. The incision that gives the easiest access to all the different parts of the joint is the semilunar cut, commencing at the tuberosity of one of the condyles of the femur; a right-handed operator will commence it at the internal condyle of the right knee and the external of the left, coming down toward the tuberosity of the tibia and returning to the other condyle. It divides the inferior patellar ligament and subjacent adipose tissue. These parts lifted up give an easy access to the joint.

3. After division of the lateral and crucial ligaments a forcible flexion of the joint will show us the condition of the joint and enable us to bring the epiphyses to turn out, so that the diseased part may be sawed off. For this purpose we use Butcher's saw and cut the femur from the joint backward.

As to the line of the cut, if this is parallel to the line uniting the lowest points of the two condyles, we will remove too much of the external condyle and get, after coaptation, a position of knock-knee. If we cut in a line perpendicular to the longitudinal axis of the femur, we remove too much of the internal condyle, and the opposite deformity is the result, *i. e.*, bow-legs. Linhard advises to cut just between the two lines described. Of the epiphysis of the tibia we remove a disc, cutting from the posterior surface anteriorly and parallel to the articular surface.

As to the thickness of the discs to be removed, we should remove all the bone diseased, but not a particle more. We should endeavor, furthermore, to have two even surfaces of equal size of bone, that perfect union by first intention may, if possible, take place.

In children the epiphyseal line has a certain importance for the future growth in length of the bones of the limb. If possible, we should spare the whole or a part of the epiphyseal cartilage. Anatomic investigations by Giraldès place the limits beyond which we are not to go as follows: In the condyles of the femur, 2 cm.; in the intercondyloid fossa, 1.5 cm.; in the tibia, 1.5 cm. Still more exact details are given by König.* The epiphyseal line is situated in a child of eleven as follows (from the articular surfaces): Internal condyle of femur, 2.4 cm.; external condyle, 2.1 cm.; anterior portion of intercondyloid fossa, 1.6 cm.; posterior part, 1.4 cm.; anterior part of tibia (near tuberosity), 3.8 cm.; posterior part, 1.5 cm.; medium inner part, 1.5 cm.; external lateral half, 1.4 cm. Each additional year adds 1 mm. to the depth of the epiphyseal cartilage. In the present case we shall cut off 2 cm. of the femur and ½ to 1 cm. of the tibia, and then, if the surfaces are healthy, unite them; if local diseased foci are present, scoop them out with the gouge rather than remove a larger portion of the epiphyseal cartilage. Should the whole epiphysis, clear to the medullary cavity, be diseased, we may have to amputate.

The patella, if diseased, is to be removed. If not, shall it be left? From Pénière's statistics we learn that saving the patella raises the death-rate 30 per cent., and more than doubles the chances for the necessity of a secondary amputation. Hodges calculates that the removal of the patella shortens the after-treatment thirty days. Holmer makes the sensible remark that the patella, if left in its place, makes the internal cavity of the wound irregular, thus making pockets for fluids that should be discharged, and besides presents possible starting-points for new caries. Therefore we shall remove the patella in this case.

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* Langenbeck's Archiv, 1867, ix, p. 177.

4. Excision of the thickened capsule is the next step. The whitish, firm or grayish elastic tissue into which the soft parts of the diseased joint are transformed must be removed. Authors differ as to the advisability of this step. The majority advise the removal of what conveniently can be, and say that particles of indurated tissue left will do no harm, but will be absorbed or will participate in the formation of the cicatrix. The minority advise the removal of every particle of the fungous capsule, even the posterior wall to the coats of the popliteal vessels. One author, Professor Albert,* of Innsbruck, advises the extreme step that we secure the popliteal artery and vein by a loop before dissecting away the adjacent capsular tissue, that no accident to these vessels may necessitate amputation. We shall, in this case, remove as much as possible of the thickened capsular tissue without resorting to the ligation referred to.

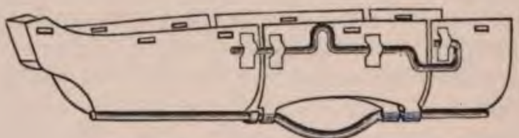

Fig. 21.—Modified Petit splint.

5. We next shall drill a hole through the bones on each side, and pass in a soft silver wire 0.5 to 1 mm. in diameter.

6. After loosening the elastic constriction of the arteries above the knee we shall stop hemorrhage by ligatures with catgut of possible bleeding vessels, elevate the field of operation, and wash it out with 2.5 to 5 per cent. solution of carbolic acid.

7. A drainage-tube will be placed between the posterior wall of the capsule and the posterior aspect of the cut osseous surfaces, *i. e.*, the tube is carried along the whole of the posterior line of the united cut surfaces of the epiphyses.

8. We then unite the silver wire sutures so as to procure a uniform and perfect contact of the cut osseous surfaces.

9. The limb is then to be placed in a padded white metal splint, with movable doors at each side of the joint, to admit of free application of the antiseptic dressings. It is a Petit splint, modified a little, as shown in Fig. 21.

The strings from the upper margin of the splint allow of the suspension of the whole limb. The pads consist of carbolized cotton covered by protective or carbolized oiled silk.

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* "Beiträge zur operativen Chirurgie," Wiener med. Presse, No. 24, 1879.

This mode of bandaging procures immobilization and gives easy access to the wound, without disturbing it, for dressing.

The fenestrated plaster bandages are good for fixing the limb, but do not permit of renewing antiseptic dressing without soiling the bandage.

A plaster dressing cannot be kept clean enough to avoid danger of septic infection of the wound.

Having placed the limb in the padded splint and brought the osseous surfaces in perfect contact, we insert another drainage-tube along the anterior margin of the osseous union and unite the wound.

First we unite the divided inferior patellar ligament. Next we unite the wound with catgut or carbolized silk, leaving only openings for the silver wire and drainage-tubes. The ends of the latter we may fasten to the skin by a stitch of silk suture, and then cut them off short and obliquely, so as to facilitate the introduction of the point of a syringe for aspirating fluids and washing out with antiseptic solution if necessary.

The operation was made with the aid of Drs. Isham, Lee, and Jacobson, of the hospital staff, and Drs. Sawyer, Clausen, and Murphy, of the house staff.

The mode of operation was as already indicated. There was no purulent fluid in the joint. The capsule was firm, whitish, and 3 to 5 mm. thick, and thickest in the region of the lateral ligaments. The whitish tissue here contained irregular sinuous cavities filled with thick, yellow, cheesy matter. The cartilaginous surfaces of tibia and condyles of the femur were superficially destroyed, with irregular nodular surfaces in which islands of denuded carious bone were surrounded by fibrous adhesions between the tibia and condyles of the femur. The adhesions were broken by forced flexion. The patella was united, with partial ankylosis, to the intercondyloid fossa of femur. It was separated by chisel and hammer. The suprapatellar bursa was obliterated. It was dissected loose, to permit the anterior flap being held away from the condyles. A disc 2 cm. thick was sawn from the condyles of the femur, leaving healthy cancelated structure.

The tibia was separated at its upper posterior margin from its periosteum, leaving this in connection with the posterior wall of the capsule, and a disc 1½ cm. thick was removed. In the external half of this cut surface was an island of firm cartilaginous tissue of the epiphyseal cartilage; the cancelous surface was healthy.

On bringing the cut surfaces together the leg was straight, as in the highest degree of extension. As we desire ankylosis in a slight degree of flexion, another and wedge-shaped piece was cut from the tibia, when the position was perfect. The patella was removed subperiosteally by the gouge. The whitish, firm tissue of the capsule was dissected and extirpated. The holes were drilled in the sides of the bones, and the silver wires inserted. After removal of the elastic compression one small artery was ligated with catgut; all further bleeding was controlled by the carbolized solution. The posterior drainage-tube was inserted, and on a suggestion of Dr. Isham was brought out through an opening cut posterior to the hamstring tendons. The bones were brought together, and the silver wires twisted; the leg placed in the splint; the anterior drainage-tube inserted; the patellar ligament united; the external wound closed with carbolized silk; the drainage-tubes stitched to the skin; the leg lifted out of the splint, and a perfect Lister dressing applied; the leg replaced, and the knee surrounded with oakum and fixed by a woolen bandage around the splint. The patient was put to bed, and the limb suspended to a wooden frame upon the bed at its lower half.

Microscopic examination of the thickened capsule, hardened in chromic acid solution, revealed miliary tubercles throughout.

October 13th: Patient walking about all day. Can walk without crutches or cane. The wound, from the scraping out on outer side of the knee, all closed up.

October 17th: The granulations on inner side knee show no signs of healing, in spite of repeated cauterizations. Patient anesthetized, and the tuberculous granulations removed by gouge and sharp spoon. A sinus was found leading along up and above the scar of the primary wound 3 cm. Wall of the sinus scraped out and drainage-tube inserted.

October 25th: Opened small abscess at middle of original semilunar incision.

November 1st: The small wound healing rapidly.

November 3d: Opened another small abscess (size of hazel-nut) in the interior part of scar. Patient walks about all day without pain.

In January, 1880, a similar small abscess formed in the anterior part of the scar.

In February, 1880, patient left hospital and began work as cutter in glove factory, being able to be about constantly.

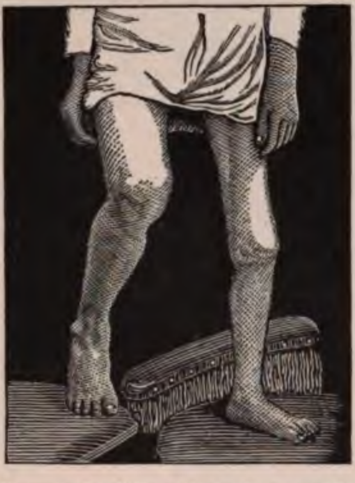

Fig. 23.—Condition of knee after complete healing.

In April a small superficial abscess again formed on the outer side of the knee. It was opened and healed in eight days.

The present condition is as follows:

Solid ankylosis in slightly flexed position. The transverse scar irregular from abscesses, ulcers, and their removal. Shortening of the extremity 1½ to 2 inches; from the anterior-superior spine of the ilium to the external malleolus, 1½ inches, and to the internal malleolus, 2 inches, shorter than opposite limb. Perfectly useful limb; can stand on it all day without pain. No trace of tuberculosis apparent in other organs of the body.

A speedy osseous union is the most important point. This secured, a final success is almost certain. In our case this occurred in the third week, and was complete in twenty-four days. It occurred as rapidly as in uncomplicated fractures frequently. It was a perfect instance of healing by first intention, and may be considered rare in its rapidity.

But it is obvious that if we can convert an excised knee-joint into a subcutaneous fracture by antiseptic methods scrupulously carried out and immobilization, we may make a rule of what has been the exception. It might be objected that such rapid healing would not occur in advanced years as in youth, as it is known that the danger of open fractures increases with the age. But Volkmann has shown, by 100 cases of compound comminuted fractures treated antiseptically, that such recover as well and as rapidly as simple fractures, and regardless of the age of patient. Formerly, 20 to 30 per cent. of such cases were lost by suppuration and pyemia; now none of them need be, provided they are treated antiseptically from the first. In excisions of the knee-joint we have the right to expect as good results under the Lister treatment as in these fractures—even better, as the wounds in the excisions are not for one moment out of the antiseptic atmosphere.

As to danger to the general health from confinement in bed, our patient was out of bed on the thirty-eighth day. Twice this length of time would do no injury.

The only accidental complication in the after-treatment was the cystitis, and that was probably due to the use of an undisinfected catheter to draw the urine during the early retention that is so common after an operation.

There was very little fever early, and some of this may have been due to the cystitis. It was not until after the bony union that some sudden rises in temperature occurred. These were due to the formation of the small acute abscesses. The tuberculous character of the fungous arthritis in our case was the cause of the only troublesome disturbance during the after-treatment, namely, the formation of abscesses, and these were neither dangerous nor serious. The primary incision healed by first intention entirely, and nowhere reopened; but about this scar the little abscesses, of the size of a hazel-nut, already described, formed, with slimy, clear fluid and slimy, viscid pus. This process is due to excessive formation of miliary tubercles in edematous adenoid tissue, thus breaking down in fatty degeneration, making small tuberculous vomicæ, and leaving tuberculous ulcers with little or no tendency to heal. This process is unaccompanied by fever or much local pain. Sometimes about such tuberculous foci are formed small abscesses in the connective tissue. One such formed in this case along the inner hamstrings, and opened on August 31st. Another, on the outer side, opened September 15th. Such abscesses cause slight fever, as occurred here. They may close up speedily and entirely, or partially, and leave a small tuberculous cavity. This, as well as the bluish, swollen, tuberculous, ulcerated, or broken-down nodules, resists all local treatment. The only effective treatment is entire removal. The wound will heal rapidly and with a permanent scar.

The cause of these secondary multiple but local eruptions of miliary tubercles is obvious. Particles of the thickened fibrous capsule of the joint, with their miliary tubercles, have been left here and there, and now form starting-points for other tubercles in soft, young, adenomatous tissue. A careful removal of all the capsule is the only way to prevent these little troubles in the after-treatment. This tendency of tubercles to grow in the scar should be a warning to us to remove all traces of such formation from the bone if deeper local foci are found here.

We are inclined to believe that those who hold the removal of all the capsule to be unnecessary have gathered their experience from cases of white swelling or chronic inflammation of the knee-joint, with few or no deposits of miliary tubercle.

Tuberculosis of elbow-joint. Excision by Dr. E. W. Lee, Chicago.

Primary osteotuberculosis of the head of the radius. Secondary tuberculous fungous arthritis tending to ankylosis. No abscesses or sinuses. Subperiosteal excision. Recovery, with joint movable and useful. Almost complete reformation of the removed osseous parts, with formation of new joint.

Mary C. B., aged eight years. Had whooping-cough at four, scarlet fever at seven, and measles a few months later. Recovery perfect. No tuberculous history. She is one of nine children; all the rest healthy, and none of them ever have had scrofulous disease.

At one year of age she fell down-stairs—only five or six steps. Three months later her mother noticed she kept the right elbow flexed at an angle of 45 degrees; it was somewhat stiff, but not swollen. The arm remained in this condition six years. No pain was experienced, and no attempt was made to move the joint. Dr. Lee first saw the child when she was seven years old. Then the joint was stiff, the member was carried in a drooping manner, as though it was a useless appendage. There was considerable atrophy of the muscles of the whole limb, but most, of the extensors of the forearm. No active motion was possible of the elbow-joint; neither flexion and extension nor pronation and supination of the forearm. By forced and very painful passive motion the forearm could be flexed 10 degrees.

The child was anesthetized and forcible movement of the joint in all directions made, to break up adhesions. The arm was then placed in a flexible splint with rubber bands. Passive motion was now made daily, and the child was induced to lift sand-bag weights. In three months she had motion of 25 to 30 degrees. Soon thereafter the joint became swollen and tender and passive motion had to be discontinued. The joint soon became as stiff as at first.

Passive motion was resumed on two occasions later, but without benefit. Each attempt was followed by pain and swelling.

Subperiosteal excision was made January 27, 1880, at the patient's home, by Dr. Lee, assisted by Drs. Fenger and Bridge. The patient was etherized, and Esmarch's bandage applied. Then, under the spray, a longitudinal incision 8 cm. long was made on the posterior side of the joint, dividing the tendon of the triceps longitudinally. The periosteum was detached by a strong gouge, thus preserving the attachment of the extensor tendons to the periosteal sac of the olecranon.

In the same way the head of the radius and the cubital epiphysis of the humerus were enucleated, leaving their periosteal covering in connection with the overlying soft tissues. In the cavity of the joint were a few drops of slimy, grayish pus. The articular cartilages were destroyed, and the bones presented partly rough, denuded surfaces, partly a soft, reddish-gray covering consisting of fungous granulations.

The olecranon was removed entire, also the head of the radius. Of the lower end of the humerus, 2 cm. in length was sawed off. The cut surfaces of bone were healthy; one small artery only was ligated, and that with catgut. A drainage-tube was inserted the whole length of the wound, which was closed with silk sutures. The Lister dressing was applied, and the arm fixed to an angular splint. Examination of the excised bone showed that the head of the radius had lost its cartilaginous covering on the articulating surfaces, and presented several small cavities or excavations 2 to 3 mm. deep, and the same in diameter. The walls and base of these cavities consisted of white, hard, and smooth osseous tissue, with no fungous granulations on the surface. The shape of the cavities indicated that probably here a primary osteotuberculosis had developed, at first in the spongy portion of the bone. These tuberculous foci had enlarged and finally reached the articular surface, opened into the cavity of the joint, and caused the fungous tuberculous arthritis. The osteotuberculosis in the head of the radius has come to an end; the cheesy matter and the lining membrane of adenoid tissue and miliary tubercles have disappeared, and left a clean cavity with no further tendency to destruction of its walls.

The articular epiphysis of the humerus presented a different stage or form of the disease. Here we find the secondary, superficial, diffuse osteotuberculosis or tuberculous caries destroying the bone from the surface. The cartilages were all gone, and the articular extremity of the bone was altered in shape and reduced in size. In some places rough, bony surfaces were present; in others irregular layers of reddish-gray, fungous granulations covering the bone. The tissue was so friable as to be easily removed from the bone, which presented then a roughened surface. The microscope showed these granulations to be adenoid tissue containing spicules of bone undergoing absorption, and miliary tubercles. The articular surface of the olecranon showed the same morbid conditions as the humerus.

The after-treatment was fortunate. No suppuration occurred. The wound healed by first intention. Drainage-tubes were removed in two weeks. Dressings were renewed every two or three days. In three weeks the wound was entirely healed.

After four days passive motion was commenced with the screw of the splint. After ten days passive motion was made at each dressing, the splint being removed.

After four weeks the splint was dispensed with and active motion commenced. Later, to force the child to use the arm, the well arm was tied to the waist and kept beneath the clothing.

She now has a very useful arm, with new-formed joint. There is 90 degrees of motion without pain, *i. e.*, flexion and extension. She uses the arm for everything, and the whole day long, without pain or fatigue.

There is shortening of the whole extremity by about 3 cm., 2 cm. of which is due to shortening of the humerus.

In examining the new-formed joint we easily feel a large, new-formed olecranon and condyles of the humerus, the external the largest.

Pronation and supination are permitted to about half the normal extent, viz., to 80 and 90 degrees. There is a slightly lessened volume of muscle of the whole extremity, amounting for the arm to three-quarters of an inch in circumference, and for the forearm to one-half inch.

The favorable course and result of the case, absence of fever and suppuration, may be due to the antiseptic methods used. The splendid result as to mobility of joint is due, of course, to the subperiosteal method of operating. We need hardly say that the older methods, with destruction of periosteum, are never to be employed where mobility of joint is expected afterward.

Will the good result as to motion of this joint be lasting?

For elbow- and shoulder-joints we know the results may be good several months after the operation, and later all active motion be lost either from ankylosis due to relapse of the fungous arthritis, or by relaxation of the tendons and ligaments of the newly formed joint, the latter producing what may be termed a loose joint.

Tuberculosis of hip-joint. Excision by Dr. E. W. Lee, of Chicago.

The case is communicated to illustrate some improvements in bandaging and dressing the patient after this operation, and because the tuberculous character of the disease in this case has brought out a measure of importance in the after-treatment.

Tuberculous fungous arthritis; caries; morbus coxarius of right hip-joint of three years' standing. Large anterior abscess. Excision subperiosteal by external longitudinal incision; the abscess emptied and scraped out from the incision. Drainage through two openings. Three months later the inclosed abscess again laid open by a large incision, and its entire wall of tuberculous tissue scraped out, the abscess closing entirely in eight days thereafter. The leg dressed in Sawyer's modification of Hodgens' splint. The dressings reapplied as often as required by means of Lee's frame for the dressing of excisions of the hip-joint.

Sarah Jane B., aged nine and one-half years. No consumption, cancer, or hip disease in family. The father's parents both living. Mother's father died in her infancy of some disease unknown; her mother living. The patient is one of a family of ten children, of which five are living and healthy; one died of cramps, one of teething, one of diphtheria, and one was still-born. No scrofula or skin disease has occurred to any of the family. She had whooping-cough and varicella at five years of age and measles at seven.

The hip disease began February, 1877. Eight months previously she had slipped down a short flight of stairs (three or four), but complained of no pain afterward and was not lame for six months. Then symptoms began. She was taken to Dr. Gunn, who recognized the hip disease and put her under treatment in St. Luke's Hospital and afterward at home. The treatment was by splints and extension by weight and pulley and was continued two months.

She improved, could walk and run and jump without appearance of lameness.

In the winter of 1878–79 she fell from a chair upon her back upon the floor. She appeared only slightly hurt, but rapidly grew lame. Six months later she was so bad she was obliged to use crutches. Early in December, 1879, the mother noticed a hard swelling anterior to the diseased joint. She consulted Dr. Lee, who pronounced it an abscess originating from a carious hip-joint and advised excision.

Operation by Dr. Lee was performed December 24, 1879, with the assistance of Drs. Fenger, Isham, Clarke, Bridge, and McLennan. At the time of operation the child was poorly nourished and had hectic. The thoracic and abdominal organs were normal. The right lower limb was shortened 1½ inches, adducted, and flexed. Active movements of the hip-joint were impossible on account of pain. Under the influence of ether, limited motion was possible, but no distinct crepitus was produced. A large fluctuating abscess was felt, reaching from the anterior-superior spine of the ilium down to the upper third of the femur anteriorly.

Under the carbolic spray a longitudinal incision was made from a point 5 cm. above, down along the outside of the trochanter major, 5 cm. The periosteum was detached from the bone, the capsule opened, and the head dislocated from the acetabulum. As the head of the bone was atrophied from superficial caries and the neck presented a tuberculous cavity (as described in a previous paper, where it is shown that the cavity reached down to the lesser trochanter), the upper extremity of the femur was removed just below the lesser trochanter. The cut surface of the femur was here healthy. The acetabulum presented several roughened surfaces, partly covered with tuberculous granulations. These were gouged out until firm osseous substance was met with. The anterior abscess was opened through the wound, and its wall scraped off and the membrane removed in pieces. A counteropening was then made at the lower extremity of the abscess, and a drainage-tube inserted through its whole length and fastened with sutures.

The acetabulum was washed out with a 2.5 per cent. solution of carbolic acid, and two drainage-tubes inserted and fixed to the respective ends of the incision with sutures, when the wound was closed with silk sutures.

A perfect Lister dressing was applied, over which was placed a layer of carbolized oakum, and the patient was placed in Sawyer's splint.

This new and splendid apparatus for dressing excised hip-joints, combining extension and suspension of the operated extremity, was first applied in the summer of 1879 in Cook County Hospital, Chicago, on a patient operated upon by Dr. Fenger.

We here give drawings of the instrument, and the written description of the apparatus, as prepared by Dr. Sawyer himself.

The splint was a modification, or rather an extension, of the well-known Hodgens' anterior splint, employed in fractures of the femur, etc. The outlining framework was constructed of five-eighth-inch iron, while the cross-bars arching over the limb and body, as hereafter described, were of three-eighth-inch iron.

The five-eighth iron bar constituting the main framework of the splint commenced at the lower border of the axillary space, on the side of the affected limb, and was extended downward to a point six inches below the foot, being molded so as to correspond, with approximate accuracy, to the outline of the body. Below the foot the bar made a square turn, extending horizontally inward about four inches; thence turning squarely again and running up the inner aspect of the affected limb to the groin. From this point it arched across the opposite groin in an oblique direction, corresponding with the inguinal fold, and at the anterior-superior spinous process of the opposite ilium took another and final turn, ascending along the opposite side of the body to its termination at the lower border of the axillary space. Arching across the limb and body, and connecting the two branches or "legs" of this framework, were five cross-pieces at the following points: first, at the upper extremity of the splint; second, extending obliquely from a point six inches below the upper extremity on the affected side to the angle of the splint corresponding to the anterior-superior spinous process of the opposite side; third, at a point corresponding to the inner and lower extremity of the fixed arch across the opposite groin; fourth, at the lower third of the thigh; and fifth, at the lower third of the leg. Of these arches, all but the third terminated on either side in a hook for the purpose of suspending the apparatus. There was a slight bend in the splint corresponding to the knee-joint, so as to allow of limited flexion, and another at the upper end of the femur, where it was bent upward at an angle of perhaps 20 degrees.

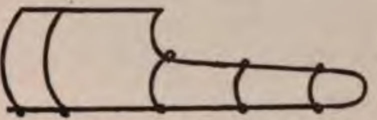

Fig. 24.—Showing the iron frame of Sawyer's splint.

This apparatus was applied after the manner of a Hodgens' splint. Adhesive straps were applied to the limb as high up as the lower third of the thigh, being secured to the limb by a roller. These straps were attached at their lower extremities to a "stirrup block," which was in turn fixed to the lower end of the splint by means of a short piece of elastic tubing.

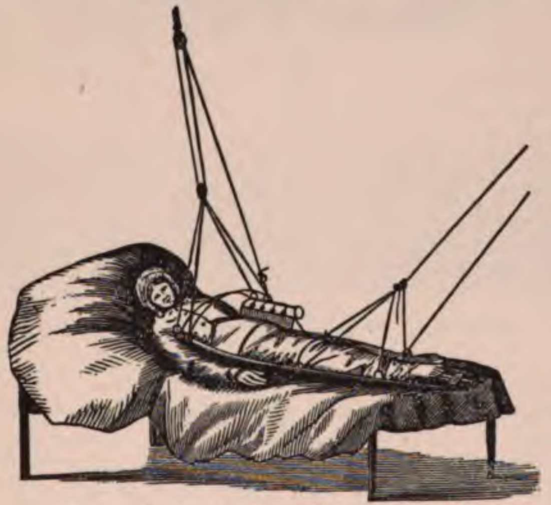

Fig. 25.—Showing the splint applied on the excised hip.

The limb and body were supported by broad strips of muslin passing underneath, and secured by pins on either side to the framework of the splint.

The apparatus was suspended by two sets of cords as follows: (1) Four converged from the four lower hooks already mentioned to a point some distance above the limb, and were attached to a line dropped from a pulley in the ceiling, a little below the foot of the bed, the degree of obliquity in the direction of this line varying with the amount of extension desired. (2) Four cords converging from the four upper hooks to a point a few inches above the body were attached to a line dropped directly downward from the ceiling, a set of compound pulleys intervening for convenience in elevating the body. For convenience in dressing the limb a block was removed from the mattress corresponding to the location of the wound. This could be replaced when not dressing.

Dr. Sawyer's splint proved in this first case—a boy of seventeen years of age—a most excellent and convenient help in the after-treatment. When the dressing was renewed, the patient hoisted himself with the upper system of pulleys, an assistant raising the limb by the lower set of pulleys; the straps covering the wound were removed after drawing the block in the mattress and the wound easily gotten at.

An important point in the after-treatment, if we would carry out all the details of the antiseptic method, is this: We must be in no hurry, but must have ample time to cleanse every part of the wound, wash out the tubes, etc., without fear of tiring the patient or causing him to get nervous or suffer pain. Therefore it is necessary to have the whole body of the patient easily suspended and high enough to enable the surgeon to get free access to the wound from below, to operate the atomizer, and to change the bed-clothes. To accomplish this, Dr. Lee devised a movable suspension frame with straps, to support the patient during the shifting of the dressing.

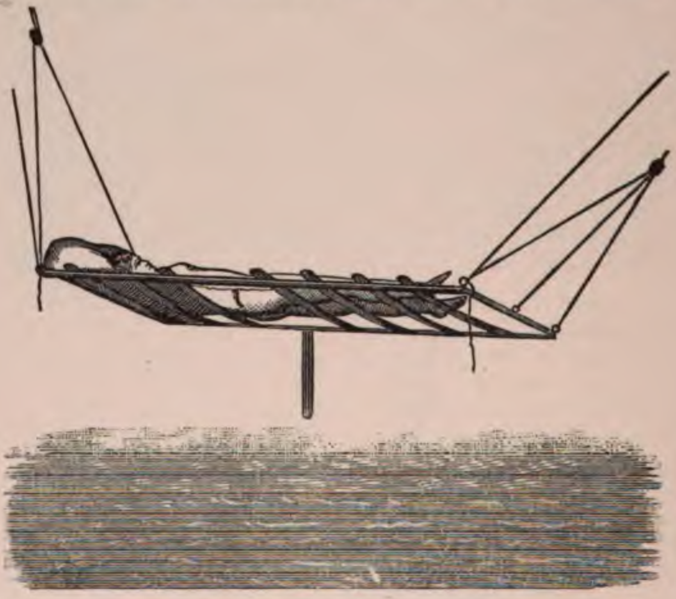

Fig. 26.—Lee's frame for dressing excisions of hip-joint.

Fig. 26 shows Lee's frame for dressing of excisions of hip-joint. It consists of a wooden frame, 6 feet long, 2½ feet wide, with cross-straps 4 inches wide and 4 inches apart. Each corner has a strong iron hook for attaching a suspension rope.

The center of each of the end pieces bears another hook for fixing the end of the rope after the apparatus is hoisted.

The mode of operating is as follows: The patient is first hoisted in Sawyer's splint 5 to 10 inches above the bed. Lee's frame is placed on the bed beneath, when the patient is lowered upon it. The ropes are then adjusted to the frame, and this is raised 2 feet, bearing patient, Sawyer's splint, and all, and fixed in this position. The patient has a pillow under his head and is perfectly comfortable.

The bed is then taken away. The straps in Sawyer's splint covering the Lister dressing are unbuttoned and removed. Next the straps in Lee's frame covering the wound are removed. The antiseptic dressing is then accessible, is easily removed, and the wound cleansed, under the spray. The bed is refreshed and the new antiseptic dressing in all its layers is prepared and laid upon the bed in the proper place, when the bed is brought under the patient and he is let down upon the dressing, the application of which is completed by bringing around the body the ends of the many-tailed bandage that hold the dressing firmly to the part.

The straps of the splint are readjusted, and the patient hoisted by this away from the wooden frame, which is now removed, and the patient is again lowered on the bed and the dressing is finished.

The description of this dressing and the apparatus may make it appear complicated and unpractical. But if you could see the dressing made upon these little patients and see them, as we often have seen them, laugh, chatter, and make fun during the whole of the tedious performance, which otherwise must be tiresome and painful, you would not entertain such an opinion of it.

The splints and dressing hitherto in use for the after-treatment of excisions of the hip-joint can none of them be used when a perfect Lister dressing is to be made without the greatest inconvenience. The plaster-of-Paris bandages of the Germans, although they may be combined with both extension and suspension, are not strong enough, when sufficiently large fenestræ are cut, for changing the dressings, they cannot be kept clean, and their renewal is attended with great inconvenience and discomfort to the patient. The best apparatus hitherto used is, in our opinion, Sayre's wire apparatus or splints.* This combines immobilization and extension. It does not permit as free access to the wound for the application of the Lister dressing as our own apparatus, neither can it be kept as clean; furthermore, it is much more expensive.

Volkmann, in a valuable monograph in 1873,† made the following remarks: "I do not deny that the invention of a, so to speak, mobile, immovable apparatus for dressing excised hip-joints, whereby cleansing the wound, defecation, etc., can be accomplished without moving the patient, would be a great advantage."

The apparatus already described has the following advantages:

1. It permits defecation, dressing the wound, changing the bed-clothes, etc., without moving the patient; it lifts the patient without moving him.

2. It can easily be kept perfectly clean.

3. It is inexpensive.

We regard it as a step toward the accomplishment of the desideratum of Volkmann.

Course of the After-treatment

December 25th: Pulse, 140; temperature, 102$\frac{1}{5}$° F.
" *26th:* " 136; " 102$\frac{2}{5}$° "
" *27th:* " 138; " 103° "
" *28th:* " 130; " 102$\frac{3}{5}$° "
" *29th:* Temperature, 101° F.
" *30th:* " 101° "
" *31st:* " 101° "
January 1st: " 101° "
" *3d:* " 103° "

" *4th:* On making the dressing the inferior opening into the abscess is completely plugged by a mass of tissue. On pulling it out it was found to be as large as a hen's egg, and consisted of tuberculo-adenoid tissue of the membrane lining the abscess.

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* Sayre's Orthopedic Surgery and Diseases of Joints, New York, 1879.

† "Die Resectionen der Gelenke," Sammlung klin. Vorträge, 1873, No. 51, p. 306.

January 5th: The temperature has fallen to 102° F.

Thereafter the temperature steadily fell, and the case progressed favorably.

In two and one-half months the hip had become so firm that the child could be moved in any way without pain. The Sawyer's splint was then dispensed with, and ordinary extension by weight and pulleys substituted.

Three weeks later the child had an attack of facial erysipelas—the patient lived in a deep basement, and something of an epidemic of erysipelas was then going on. Only the head, neck, and shoulders were involved, and the attack lasted two weeks.

The erysipelas had no effect on the wound. During its course, however, the precaution was taken to dress the case oftener, viz., every two instead of every four days.

After convalescence from the erysipelas was established the granulation tissue in the lower opening of the abscess broke down and the discharge increased in quantity and continued in spite of antiseptic precautions. As the granulation tissue of the now almost closed excision wound showed symptoms of breaking down, it was deemed advisable to extirpate the walls of the abscess.

This operation was made March 30th under anesthesia. The abscess was freely laid open, and was found to communicate by a sinus with the excision wound. This sinus extended to a denuded osseous surface above the upper posterior border of the acetabulum on the iliac bone. The upper end of the femur and the acetabulum were united and surrounded by a firm connective-tissue mass in which no sinuses or traces of inflammation could be found.

The abscess was lined with a grayish, soft, friable, but adherent membrane, 1 to 3 mm. in thickness, with smooth surface and without visible miliary tubercles. This mass was entirely scraped off down to healthy fibrous and muscular tissue. The denuded osseous surface was also scraped out. The hemorrhage was insignificant. Two drainage-tubes were inserted, one along the whole length of the abscess, the other reaching to the denuded bone, and being brought out through the old excision opening. Microscopic examination showed the excised membrane to consist of adenoid tissue and thousands of miliary tubercles.

April 1st: The Lister dressing was reapplied and no pus flowed from the abscess.

April 3d: Some pus came out of the upper posterior drainage-tube. In one week the tube was removed from the abscess, and in three days the sinus left by the tube had closed.

Two days later the second tube was removed, and now a little sinus is left leading to the denuded bone.

The second point to which we wish to call special attention in the treatment of this case is the careful removal of the tuberculous lining of the abscess.

As Volkmann has advised, these abscesses should be laid open throughout their whole length. If in our case this had been done at the first operation, probably its repetition would not have been called for. We feared at first to make this thorough operation on account of the large external wound it required, and so our first scraping out was not effectual.

As experience has shown that the external wound, independently of its size, as well as the wall of the abscess, closes by first intention when the tuberculous matter is all removed and the operation is done antiseptically, we need not fear to make free and large incisions.

Such an operation as this is the only means we have of closing tuberculous abscesses and of saving our patients from the dangers incident to exhausting suppuration, and in time amyloid degeneration of kidneys, spleen, and liver, and from general tuberculous infection.

TRACHEOTOMY IN CROUP AND DIPHTHERIA, WITH CASES*

WITH E. W. LEE, M.D.

THE main object in writing this paper and reporting these cases is to contribute our mite toward rescuing this operation from the doubtful position it occupies as a remedial measure and placing it in the position it merits.

Most authors in writing on this subject mention the operation as one that may be done under certain circumstances, and admit that lives possibly have been saved by it that otherwise would have been lost. To Trousseau belongs the credit of reviving and, in France, popularizing the operation. His unfailing faith through a series of years and the magnificent success attending his efforts are worthy of emulation for all time. It may be said that in his enthusiastic advocacy of it he resorted to the operation in many cases that would otherwise have recovered, and hence his large average of successes. Admitting this, it proves that the dangers following the operation are not so grave as had been supposed, and also that the earlier it is resorted to, the greater the chance of a successful issue. Vogel, in his work on Diseases of Children, says, in the article on Croup (chapter iv, p. 259): "I have never yet seen a child recover from the genuine fibrinous croup, but from the diphtheric form, three children out of twenty or twenty-five have recovered." Further on (p. 267), in speaking of tracheotomy as a remedial measure, he says: "Let us assume that all the children operated on had genuine croup, the rate of recoveries (22 per cent.) is, nevertheless, an extremely unfavorable one, and especially since the greater portion of the children operated on suffered from the milder diphtheric forms." He also says that he neither advocates nor opposes the operation when proposed by other physicians.

Barclay, in his article in Holmes' Surgery on Croup and Diphtheria, says: "English medical men seem now very generally to incline to the opinion that the operation, if not to be recommended, is at least justifiable, as it does not materially increase the risk of a fatal issue, and unquestionably in some cases offers the only chance of recovery, *but to be successful it must be performed at an early period of the attack.* (The italics are ours.) Dr. E. H. Bennett, of Dublin, Ireland, says,† in relating a case where he had operated, "I make no apology for bringing forward this case, because most of the members know that tracheotomy for croup is rarely performed in Dublin, in consequence of the objections to the operation put forward by the late Mr. Porter, and the result of his strong objections to it has been that very few of us have had any experience of the operation." After alluding to Mr. Spence's experience, "ninety-five cases, recoveries one in three," he concludes: "Even with this condition of affairs I think we should set aside the opinion of Mr. Porter and hold the operation to be admissible."

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* Chicago Med. Jour. and Examiner, 1880, vol. xli, p. 337.

† Dublin Journal of Medical Science, 1880, 3 s., vol. lxix, p. 250.

French surgeons, as a rule, favor the operation, and in consequence of its timely performance have a high average of successful cases. In America the operation was not much in vogue until the last decade. Meigs and Pepper, in 1870, in Philadelphia, consistently advocated the performance of the operation in suitable cases, and in the eastern cities it is now being practised with a steadily increasing average of successful cases. Coming near home, we have in this State many earnest disciples of Trousseau, and, judging from the success of their efforts, not unworthy ones either.

Dr. H. Z. Gill, of Jerseyville, Ill., in his report to the State Medical Society, gives a very elaborate exposition of the standing of the operation in our midst; he earnestly and consistently pushes its claim to recognition, and very pertinently remarks that out of the 200 or so deaths from croup and diphtheria in the city of Chicago, between 40 and 50 might have been saved had the operation been resorted to. Drs. Bogue, Johnson, Andrews, and others of Chicago have been operating for several years, and, considering the desperate character of the cases, with a high average of successful results. In the concluding portion of Dr. Gill's report he gives the opinion of some medical men in the State regarding the operation. One gentleman says he regards it as an unphilosophic, irrational remedy, the results not justifying its performance. Another says a congress of physicians could not persuade him to operate in diphtheria, but in croup he is always ready to be up and at it.

From this it will be seen that professional opinion is by no means a unit on the merits of the operation. The only way to settle the question is by practical experience. The man who condemns the operation and denies the patient the chance afforded by its performance assumes a far greater responsibility than he who operates on every available opportunity and conscientiously carries out the after-treatment. We take the ground that, as medical men, when all medical means have failed, we have no right to deny the little sufferer the last chance for its life, and, furthermore, that the parents have no moral right to do this either. In an experience extending over a number of years we can say that in no case where the operation has been advised and the advice rejected—and they have been many—has the child recovered. We trust the time is not far distant when the medical attendant will be as ready to perform tracheotomy as a life-measure as he now is to adjust the obstetric forceps on an impacted head.

Within the past nine months we having been treating these cases (croup and diphtheria) by a continuous spray of chlorate of potash solution with 1 per cent. of carbolic acid, also lime-water carbolized to the same degree, and the success which has attended our efforts rather complicates than otherwise our selection of cases for operation.

Out of a series of between 30 and 40 cases of all forms there have been no fewer than 8 recoveries where the larynx was involved, and which might under ordinary circumstances be considered suitable cases for operation. We do not claim that the treatment is new, but we do claim that it is more effectually carried out by means of large atomizers, so that the atmosphere of the apartment can be thoroughly saturated with the spray, and the little patient need not be alarmed by the proximity of the apparatus. The atomizer may best be placed in the center of the room, several feet away from the patient. After a careful trial of the various remedies used in the form of spray, we have come to the conclusion that lime-water with 1 per cent. of carbolic acid and 4 per cent. of glycerin possesses more solvent power over the membrane than any other. The grand question to be decided is when to operate. If we operate early, we have the satisfaction of saving a larger percentage of cases, but feeling doubtful if some of these would not have recovered without surgical interference. If we operate late, we know by experience the rate of mortality rises to a discouraging height. So the first question that naturally arises is: Does the operation *per se* jeopardize the patient's life? We think to a slight extent it does.

As regards the actual performance of the operation, from our experience we are of the opinion, if due care be taken, the chances of mishap are so trifling as to cut but a small figure in the case. This may smack of temerity when we consider that Gross—that surgical veteran—says that he knows of no operation he approaches with greater dread than that of tracheotomy when the subject is a child with a short, fat neck. There is a dissimilarity in the difficulties attending this procedure which does not attend any other operation that we have been accustomed to perform. In Case 15, which was the child with the fat neck,—and a truly difficult operation it proved,—it seemed as if we never would reach the trachea; yet in Case 16 the patient, about the same age and fully as robust, the trachea was exposed by a few strokes of the scalpel, and the operation completed with the utmost facility.

The actual danger attending the operation commences at its completion. The presence of the tube and the direct entrance of air into the bronchi no doubt have an influence in producing those pulmonary complications which so often prove fatal, but their influence must not be overestimated, as in many cases these complications are in existence before the operation has been attempted, the cause being the prolonged stridulous breathing, the operation not being resorted to in time.

We will not stop now to describe the operation and the danger attending it, which may be seen in any text-book on surgery. We may remark, however, *en passant*, that in opening the trachea we insert two tenacula, one each side of the site of incision. By this means we not only steady and lift the trachea, but by diverging the instrument at the point of insertion we make the opening wide enough to admit the tube without difficulty. A very excellent device is to pass through the outer tube a closely fitting, soft-rubber catheter, so that its point just projects beyond the end of the tube; the rubber being pointed, soft, and pliable, readily pushes its way into the trachea without injuring the tissues. As regards the many instruments which have been devised for executing this manœuver, we would not recommend any one to attempt the operation until he can dispense with their aid.

Martin, of Boston, has operated, dispensing with the tube entirely. He cut down on the trachea in the usual manner, and by means of silk thread or silver wire passed through the trachea at the edges of the incision he holds them apart. Another plan is to make a circular flap in the trachea and have it held back. These modifications we have not yet tried, but, considering that the presence of a silver or rubber tube in the wind-pipe must be a source of irritation, they are deserving of a fair trial. Dr. Martin has had good success.

We now treat all cases of croup and diphtheria, whether there be laryngeal implication or not, by the continuous spray of lime-water with glycerin and carbolic acid, in the proportions before mentioned.

We must digress somewhat in order to consider the subject from a pathologic point of view. It is now beyond doubt that a sphero-bacterium—the so-called micrococcus diphthericus—is constantly found in the membrane of diphtheria and croup. Whether this minute organism is the product or bearer of diphtheric poison, or is only an unessential concomitant, finding the diphtheric infiltrated tissue the proper soil to thrive in, we do not know.

Our knowledge about the character of the poison in contagious and miasmatic disorders is yet so defective that rational therapeutics, based on anything but the blind *a posteriori* experience of olden times in most of these diseases, has hitherto been an impossibility. Even if the micrococcus be no essential element of the diphtheric poison, it is an element, and the only one the presence of which we are sure of. It is rational, therefore, that we take this as a hint to a rational treatment, especially as most of the measures heretofore proposed have been abandoned because, after fair trial, they have proved to be useless. The first remedy to choose, of course, is some substance that will destroy the life and development of these micro-organisms—*i. e.*, antibacteric remedies. As to the point of application of these remedies, it is natural to apply them to the air-passages, as these parts are not only the main seat of the local disturbance of the disease, but most likely the parts through which the poison invades the body.

The inhalation of atomized fluid, as was said before, is nothing new, but we believe most of the older instruments were inefficient, and that antiseptic solutions for atomizing have not been used with the constancy and faithfulness they deserve.

Cases 11 and 12 (Lee's) are fair examples in support of the treatment. Case 13 at first improved, but subsequently suffered a relapse. The chances for recovery would have been much better had the operation been resorted to at the first symptom of relapse. Cases 16 and 17 had been treated with the spray for several days before operation, and the condition of the membrane and the ease with which it was expelled speak volumes in favor of the treatment, as it must be recollected that these were cases of genuine diphtheria, where hitherto operative interference has been regarded as utterly futile. Where the evidences of blood poison are well marked, the laryngeal involvement and septic influence progressing *pari passu*, it is folly to suppose an operation could be of any benefit; where the characteristic listlessness is present, there is not the acute suffering for want of sufficient oxygen that exists in cases where the obstruction exists without the septic influence predominating; so it may be summed up that by the employment of antiseptic remedies, with the timely performance of tracheotomy in suitable cases, we give the patient a double chance. The antiseptic treatment *per se* is, no doubt, a powerful agent in our hands in battling with this dread disease, and in a certain number of desperate cases has proved an efficient remedy, but, as we understand it, we would not feel justified in trusting to it alone in cases grave enough to suggest operative interference.

With a view of testing the correctness of this theory, we would recommend a faithful and efficient application of the remedy, the patient having been placed under the spray, the internal medication consisting of quinin and alcohol in large and frequently repeated doses. And here we must again digress to protest against the employment of any depressing agent in treating these diseases. We are convinced that it is a septic poison generated in a congenial soil, and consequently must regard the use of emetics, escharotics, arterial sedatives, etc., as unphilosophic and irrational.

If under the spray and internal stimulation the improvements be not steady and progressive, operative interference should be immediately resorted to, provided the nervous system be not overwhelmed by the septic poison. Every hour's delay enhances the danger, so quickly and surely the dreaded pulmonary complications are added to the previous difficulty. In Dr. E. H. Bennett's case, an examination made between ten and eleven o'clock in the forenoon failed to reveal any complication in the chest, yet in the evening there was a well-defined pneumonia, and at the time of the child's death—one o'clock the next day—the greater part of the lung had become absolutely solid. Remove the tube as early as possible (we commence on the fourth day)—if only for an hour it can be dispensed with a point is gained; next trial the child can breathe without its assistance for a longer period, and so on. The presence of the tube is a constant menace, and this fact should not be lost sight of.

In Case 16 (Lee's) the child had pneumonia when operated on, and it was particularly desirable that the tube should be dispensed with as quickly as possible. At the end of the fourth day Dr. Lee removed it, and remained with the child for ten hours. Though at first the breathing was quite difficult, he refrained from reintroducing the tube, preferring to wait until it grew absolutely imperative. In a couple of hours the parts appeared to accommodate themselves to the altered condition, so that in twelve hours there was no further danger from that quarter.

M. Cairn, in the St. Louis Courier of Medicine, in reviewing the causes which may constitute an obstacle to the removal of the cannula, men-

NAME.	AGE.	CAUSE.	RESULT.	RESIDENCE.	OPERATOR.	DATE.	REMARKS.
1. Nannie Keegan .	3 years, 10 mos.	Diphtheria.	Died.	Chicago.	Dr. E. W. Lee.	Aug. 29, 1877.	Sick three days. Used chloroform. Lived thirty hours.
2. John Phalon....	4 years.	Diphtheria.	Died.	Chicago.	Dr. E. W. Lee.	Oct. 18, 1877.	Sick two days. Asphyxia imminent. Gave chloroform. Lived two and a half days. Died by asphyxia.
3. Clara Nolan	7 years.	Membranous croup.	Recovered.	Chicago.	Dr. E. W. Lee.	Oct. 23, 1877.	Two weeks complaining. Chloroform. Artificial respiration necessary after the operation. Removed tube sixth day.
4. Matthew Curran	4 years.	Membranous croup.	Died.	Chicago.	Dr. E. W. Lee.	Nov. 17, 1877.	Sick thirty-six hours. Lived two and a half days. Died by exhaustion. Chloroform.
5. Eddie Nolan....	4 years.	Membranous croup.	Died.	Chicago.	Dr. E. W. Lee.	Nov. 23, 1877.	Sick five days. Chloroform. Lived twelve hours; died of exhaustion.
6. Elice Purcell....	3½ years.	Membranous croup.	Died.	Chicago.	Dr. E. W. Lee.	Dec. 7, 1877.	Sick four days. Lived four days. Died from asphyxia. Chloroform.
7. Mich'l O'Rorque	2 years, 2 mos.	Membranous croup.	Recovered.	Chicago.	Dr. E. W. Lee.	March 18, 1878.	Sick two days. Removed tube fourth day. Chloroform.
8. James O'Grady .	2 years, 4 mos.	Membranous croup, no membrane visible.	Recovered.	94 Brown St., Chicago.	Dr. E. W. Lee.	Oct. 12, 1878.	Three days sick. Tube worn nine days. Chloroform. Condition: Pulse, 140; respiration, 48; temperature, 103.5° F.; laryngeal obstruction permanent forty-eight hours; whispering voice; nasal dilatation; retrocession of the base of the thorax marked; slight glandular enlargement. Low operation. Anesthetic difficult of toleration.
9. Albert Caproni..	4 years.	Diphtheria.	Died.	254 S. Halsted St., Chicago.	Dr. E. W. Lee.	Dec. 9, 1878.	Four days sick. Died on fifth day after operation. Exhaustion from blood-poisoning. Chloroform well borne. Condition: Pulse, 130; respiration, 36; temperature, 102° F.; laryngeal obstruction present forty-eight hours; tonsils soft; palate and fauces covered with a thick exudate;

							husky voice; dilated nostrils; epigastric sinking; glandular enlargement in neck. Low operation.
10. Lucy Gray	3 years, 3 mos.	Cynanche trachealis, croup.	Died.	341 Fulton St., Chicago.	Dr. E. W. Lee, assisted by Drs. Van Buren, Bridge, and Landis.	Dec. 27, 1878.	Four days sick. Tube worn and lived twenty-six hours. Cause of death, exhaustion. Chloroform. Condition: "Asphyxiated, death imminent." Low operation. Parents grateful that the operation was done. Should have been done earlier. Diphtheria suspected.
11. Lucas West	3 years, 3 mos.	Diphtheria.	Died.	S. Dearborn St., Chicago.	Dr. E. W. Lee.	Aug. 16, 1879.	Lived sixty hours after operation. Immediate cause of death, asphyxia caused by extension of membrane. Anesthetic, chloroform. Impending suffocation at time of operation. Low operation.
12. Aaron West	5 years.	Diphtheria.	Recovered.	S. Dearborn St., Chicago.	Dr. E. W. Lee.	Aug. 17, 1879.	Duration of previous illness, five days. Tube worn one week. Pulse, 160; respiration, 60; temperature, 103° F. Low operation.
13. Norah Ryan	2 years.	Membranous croup.	Died.	48 Gurley St., Chicago.	Dr. E. W. Lee.	Dec. 27, 1879.	Duration of previous illness, one week. Lived fourteen hours after operation. Immediate cause of death, exhaustion. Anesthetic, chloroform. Pulse, 168; temperature, 103.5° F. Low operation.
14. W. Madden	3 years.	Diphtheria.	Died.	Eighteenth St., Chicago.	Dr. Lee, assisted by Dr. Guerin.	Jan. 1, 1880.	Duration of previous illness, three days. Lived twenty-four hours after the operation. Immediate cause of death, asphyxia. Anesthetic, none. Pulseless, deeply cyanosed. Respiration almost ceased. Low operation rapidly performed.
15. Alice Green	3 years, 3 mos.	Diphtheria.	Died.	Blue Island, Ill.	Dr. Lee, assisted by Drs. Herman and Kaufman.	Jan. 19, 1880.	Previous illness, eight days. Lived six days. Cause of death, pneumonia Anesthetic, chloroform. Pulse, 144; respiration, 48; temperature, 103° F. Low operation.

NAME.	AGE.	CAUSE.	RESULT.	RESIDENCE.	OPERATOR.	DATE.	REMARKS.
16. C. J. Byrne.....	3 years, 6 mos.	Diphtheria.	Recovered.	W. Randolph St., Chicago.	Dr. Lee, assisted by Drs. W. E. Clark, Norman Bridge, and son of Dr. Byrne.	Feb. 5, 1880.	Previous illness, seven days. Tube worn seven days. Anesthetic, chloroform. Pulse, 144; respiration, 64; temperature, 101° F. Exudation of membrane over the soft parts of palate and tonsils. Low operation.
17. H. Graft.......	7 years.	Diphtheria.	Recovered.	166 Brown St., Chicago.	Drs. Lee, assisted by Drs. McLennan and Leneman.	April 20, 1880.	Previously ill, ten days. Tube worn five days. Anesthetic, chloroform. At time of the operation: Pulse, 132; respiration, 48; temperature, 102° F. Head thrown back, lips blue, face pale; epigastric retrogression. Two hours after operation: Pulse, 112; temperature, 101° F.; respiration, 36. Breathing with perfect freedom. High operation.
18. Einzvahl.......	3 years.	Membranous croup.	Recovered.	West Indiana St., Chicago.	Dr. Christian Fenger, Surgeon to Cook County Hospital.	Oct. 18, 1878.	Previous illness, three days. Anesthetic, none. Dyspnea urgent. Pulse and temperature high. Tube worn five days.
19. F. Gehrig......	2 years.	Diphtheria.	Died.	Chicago.	Dr. Fenger.	Oct. 25, 1878.	Previous illness, ten days. Died October 26th. Immediate cause of death, collapse. Condition at the time of operation, collapsed. High operation.
20. H. Kenzie......	8 years.	Diphtheria.	Died.	Penn St., Chicago.	Dr. Fenger.	Sept. 30, 1879.	Previous illness, eight days. Lived four hours after the operation. Immediate cause of death, collapse, hemorrhage. Severe dyspnea, extensive diphtheric exudation. Marked symptoms of blood-poisoning. Anesthetic, chloroform.

21. William Archer. .	3 years.	Diphtheria.	Died.	Chicago.	Dr. Fenger.	Oct. 27, 1879.	Previous illness, ten days. Lived twenty hours. Immediate cause of death, exhaustion. Anesthetic, none. Diphtheric exudation on tonsils, soft palate, and extending into the larynx. Pulse rapid and feeble. Blood-poisoning. High operation.
22. O. Malkon.	4 years.	Diphtheria.	Recovered.	Chicago.	Dr. Fenger.	Dec. 21, 1879.	Previous illness, seven days. Tube worn fourteen days. Anesthetic, none. Tonsils and soft palate covered with diphtheric exudation. Pulse and temperature high. High operation.

tions prominently two varieties of tracheal constriction. The first variety, although rare, has, however, been demonstrated in a certain number of cases. It arises through the presence of fleshy growths springing from the wound, especially through those deeply seated upon the borders of the tracheal incision, and which grow in the midst of a cicatricial tissue projecting into the air-passages after the closure of the cutaneous wound. The second variety, up to the present time, has not been described at all.

A tracheotomized child was seized with a fit of suffocation just as the physician was attempting to effect a permanent removal of the cannula. Examining the depths of the tracheal wound, he perceived a reddish prominence in the interior of the trachea, which was taken for fleshy vegetation of the posterior wall. The child died in a fit of suffocation. Professor Guyon recognized, upon the postmortem specimen sent him, that the projection regarded during life as vegetation was formed by the posterior wall of the trachea itself, which was folded longitudinally in its entire thickness. This folding was itself due to the approximation of the posterior extremities of the tracheal rings, separated anteriorly for the introduction of the cannula.

M. Currie, experimenting with the view of discovering the conditions of the production of this protrusion, concluded that this particular variety of constriction, which hitherto had not been pointed out, ought to be, nevertheless, rather frequent among children. It occurs after the introduction of the cannula, and the more readily according as the membranous span which lies between the posterior extremities of the rings is large. It affects chiefly first the three rings of the trachea. The projection which results produces a tracheal constriction that may persist and prove a permanent obstacle to the removal of the cannula.

THE ENDOSCOPE IN THE LOCAL TREATMENT OF CHRONIC GONORRHEA OR GLEET AND GONORRHEAL RHEUMATISM*

WITH A. HINDE

I. The Endoscope

It was in the first quarter of the present century that the experiment was first made to render visible the urethral canal from its meatus to the bladder—by Barini, in Frankfort, in 1806; Fisher, in Boston, in 1824; Segalas, in Paris, in 1826; and Hacken, in Riga. These experimenters failed to attract professional attention.

To Desormeaux, after years of arduous toil in this field of investigation, we owe the credit of successful accomplishment. In 1852 he exhibited his endoscope in the French Academy. In 1865 he published his valuable monograph† on this subject, in which he advanced a series of facts and original observations which have opened up a new path in the diagnosis and treatment of urethral diseases.

Desormeaux's instrument is too well known to need description here, therefore we shall mention only a few details, showing some defects in his original instrument. Desormeaux's lamp gave insufficient light, and on this account Bruns used the calcium light, and Dr. Andrews, of Chicago, the magnesium light. These modifications were too complicated and hence were not generally used. At the present time kerosene or kerosene and camphor forms the burning material for the lamp. Desormeaux's lamp is connected with a tube containing a reflector and telescope; to the end of the latter are connected the urethral tubes. Desormeaux's instrument is too costly—one hundred and fifty francs (twenty-five to thirty dollars) and also too complicated for general use, and consequently simplified instruments have been invented by Warwick‡ and Wales,§ but their instruments have not come into general use, and Fürstenheim pronounces them inefficient.

After several years of experimentation with a view of simplifying the endoscope I decided upon the use of the following instrument:

1. For the lamp, a circular wick; ordinary kerosene is all sufficient.
2. A common laryngoscopic reflector is also needed, but if sunlight can be obtained, a plain reflector will best answer our purpose.

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* Chicago Med. Review, 1880, vol. ii, p. 536.

† De l'endoscope et de ses applications au diagnostic et au traitement des affections de l'urethre et de la vessie, Paris, 1865.

‡ Brit. Med. Jour., 1867, vol. ii, p. 124.

§ Virchow's Jahresbericht, 1868, vol. ii, p. 180.

3. The tube for the urethra, as shown in Fig. 27, is funnel shaped at the outer end, and throughout the remainder of its extent is cylindric, of one diameter, and is provided with a movable plug, *a*, to facilitate its introduction within the urethra.

The material of which it is formed is pure silver, and the interior of the tube is carefully polished longitudinally, instead of being blackened, as in Desormeaux's instrument, so as to utilize the entire light thrown into the expanded outer extremity. The tube is 6 to 7 mm. in diameter, and 13 to 18 cm. in length, the latter length being sufficient to explore the vesical neck.

4. The applicator, as shown in Fig. 28, consists of a cylindric gold receptacle, at one end attached to a silver or copper wire, terminating at the opposite end in a handle. The diameter of the wire is 1½ mm., and the length of the entire instrument 24 cm. In the golden cylinder, *c*, we embed a pencil of sulphate of copper. The impure variety of the latter is to be preferred because of its less friable nature, or we may use a pencil of diluted nitrate of silver. The embedding substance is shellac, which is first melted in the cylinder, before the insertion of the caustic pencil.

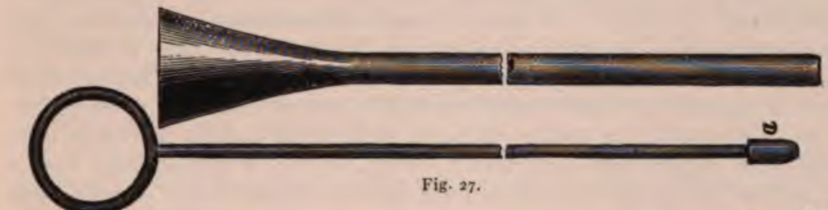

Fig. 27.

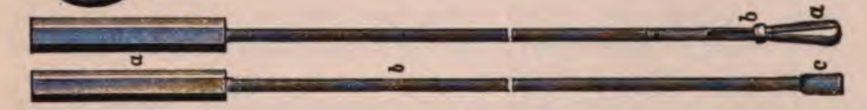

Fig. 28.

The cotton and brush holder, which is made of copper wire, has a similar handle, and is of the same length as the foregoing applicator; it is split at the inner end, *a*, forceps-like, and has a ring attachment, *b*, to fasten whatever material is desired to swab out the urethra. A piece of sponge or cotton is generally used to clean away the mucus, etc. To complete our armamentarium, Desormeaux's probe may be added to our list.

If it be possible, by means of the foregoing instrument, to get as good a view of the posterior portion of the urethra as we could by means of Desormeaux's endoscope, as we claim we can, then this method has the following advantages over his:

(*a*) It is less costly, for the lamp and mirror are the same as those used for the larynx and ear, etc. Therefore the only outlay will consist in the cost of the tube and other instruments.

(*b*) It is easier to introduce the applicator, etc., through our funnel-shaped tube than through the linear opening on the under surface of Desormeaux's tubes.

II. CHRONIC GONORRHEA OR GLEET

There is no doubt that endoscopy has advanced the diagnosis and treatment of this disease considerably, and most of the modern authors on this subject are agreed upon this point.

As bearing upon this matter we ask permission to quote from a few of the most prominent writers: Cruise, of Dublin, says: "I dare to hope that the endoscope in the future will produce as complete a revolution in our knowledge of many obscure diseases of the urethra as stethoscopy in its period has done for the diseases of the heart and lungs."*

Fürstenheim, of Berlin, says that "the endoscope is of such importance in the diagnosis of gleet that in future we can no more abide by the diagnosis of gleet than we can by that of leukorrhea as a disease *per se*."†

Tarnowsky, of St. Petersburg, says, in his recent large monograph on gonorrhea‡ (p. 146): "It was not until Desormeaux's invention that we were enabled to arrive at a precise knowledge of what we have to encounter in a chronic inflammation of the urethra." He is sorry that this advantage is so little employed at the present time. Chronic gonorrhea, blennorrhea, la goutte militaire, means only a slight discharge that continues indefinitely, and, like a cough, is only a consequence and a symptom belonging to or dependent upon a disease in the deeper parts of the urethral tract. Such a symptom loses its value as soon as by other means we are enabled to make a correct diagnosis of the disease of which this is merely a symptom.

Gleet is well known to be an obstinate and stubborn disease as concerns its treatment, but under these improved methods it will become more and more amenable in proportion to the more extended use of the endoscope, thus showing that the relapses are always due to imperfect cure at the diseased locality.

The different morbid conditions of the urethra, upon which the discharge or acute exacerbations depend, and which were formerly called gleet, are the following:

1. *The Superficial Inflammation of the Mucous Membrane in the Posterior Part of the Urethra.*—This most frequently follows an acute gonorrhea, and has no other symptom than a slight, whitish discharge in the morning. It is often interrupted by acute attacks of gonorrhea, due to improper diet, liquor, or coitus, and is often followed by epididymitis. Bougies can be introduced with little pain or resistance. Through the endoscope we see the mucous membrane in the entire

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* "The Utility of the Endoscope as an Aid in the Diagnosis and Treatment of Disease," Dublin Quarterly Journal of Medical Sciences, 1865, vol. xxxix, p. 329.

† "Ueber Endoscopie der Hahnröhre und Blase," Berlin. klin. Wochenschr., 1870, vol. vii, p. 29.

‡ Vorträge über venerische Krankheiten, Berlin, 1872.

posterior half of the urethra markedly injected, smooth, and of dull appearance, because its epithelium is absent. This injected portion is not sharply defined, but passes insensibly into the normal mucous membrane of the anterior portion of the urethra. This disease is most frequent and also most benignant, as the material for stricture has not been organized as yet and possibly never will be. In spite of the superficial character of the inflammation, it is often very slow in subsiding under the ordinary treatment.

CASE I.—*Superficial urethritis of two months' standing. Local treatment for three and one-half months. Recovery.*

V., aged twenty-three. Student. Commenced treatment December 14, 1871. Five years previously contracted a gonorrhea that lasted six months; two years later a similar attack; two months ago a gleet without pain and with a scant discharge. A bougie (Charrière) No. 18 passes easily into the canal. Through the endoscope we find the whole posterior half of the urethra diffusely injected, but with no visible swelling of the mucous membrane. The sulphate of copper was applied every three days; the patient used an injection of sulphate of zinc and later one of subnitrate of bismuth.

January 27, 1872: The discharge continues; stopped the copper and substituted a stick of diluted nitrate of silver once a week.

February 4, 1872: The discharge has increased considerably, therefore the nitrate of silver was stopped; recommenced the sulphate of copper and gave a mixture of cubebs and alum, 1 ounce to the dram, of which a teaspoonful is given three times a day.

February 20, 1872: Discharge stopped.

March 3, 1872: Mucous membrane of the posterior portion of urethra normal in appearance. The mucous covering of the membrane contains no pus-cells, but only squamous epithelial cells.

CASE II.—*Superficial urethritis. Local treatment for two months. Recovery.*

S., aged thirty. Well-nourished, robust male, had in June, 1868, his first gonorrhea, which was cured by the usual treatment in from six to seven weeks. In the spring of 1869 he found, without any known cause, a drop of white matter every morning in the meatus urinarius, and from time to time slimy matter passing while at stool.

Injections of nitrate of silver, sulphate of zinc, subnitrate of bismuth, combined with internal use of copaiba, decoctum uvæ ursi, sitz-baths, bougies, etc., caused the discharges to cease after two months, but only to return again in August after a coitus with a condom, in the form of an acute gonorrhea, and this was accompanied by an acute epididymitis on the right side. In spite of the usual treatment the gleet continued for six months. It then stopped for two months; returned in March, and was not subdued by any treatment.

June, 1870: Local treatment was commenced. Introduction of bougies showed no constriction in any part of the urethra nor any sore points. Mucous membrane in bulbomembranous portion was darkly injected for an extent of 5 to 6 cm., and in this portion was seen a little whitish matter covering the mucous membrane, consisting of pus-cells, even when it was impossible to notice any discharge on pressure at the meatus urinarius. The sulphate of copper was applied twice a week. On the succeeding day, after the application, an augmented discharge was noticed in the morning, but on the next morning the discharge was lessened and thinner, and thus it continued for five weeks, when he disappeared on a voyage for one month. On his return there was a little milky moisture at the meatus each morning, but so little that a specimen could not be obtained on a microscopic object-glass for examination.

The application of sulphate of copper three times a week for three weeks stopped the discharge entirely. Late in September he commenced coitus without any discharge, and in December there was no noticeable redness of the mucous membrane.

CASE III.—*Superficial urethritis of four months' standing. Local treatment for two months. Recovery.*

V., sea captain, aged thirty, healthy man. Four years ago contracted first gonorrhea, which lasted four months. One year later, second gonorrhea, which lasted six months. In the summer of 1869, after coitus with condom, a discharge set in which stopped in a month after the usual treatment.

May, 1870: Acute gonorrheal attack, treated by one injection of nitrate of silver (1 : 50). Later, a solution of sulphate of zinc, cubebs, alum, etc. The gleet remained, and for this he came under treatment the following September. Through the endoscope was seen, in the posterior part of the urethra, a patch of redness 5 cm. long, but no noticeable swelling in the mucous membrane. The latter was, however, covered with a small amount of whitish, mucous matter, containing numerous pus-cells, but only few epithelial cells. The sulphate of copper was applied three times a week, and in two weeks the discharge stopped.

He went on a voyage for one week, and the discharge returned. After this he was treated every second day for two weeks. Treatment was now purposely suspended, to test the recurrence of the discharge, and it was not until the fifth day that he could gather a sufficient quantity on an object-glass for an examination. This demonstrated very few pus-cells, but many epithelial cells in different stages of development, from a nucleus surrounded only by a rim of protoplasm to a fully developed squamous epithelial cell. Consequently the treatment was continued two or three times a week until the end of November, when a sample of the mucus from the deeper part of the canal was taken on a glass rod or pipet, and, under the microscope, showed no pus-cells, but only epithelial cells in various stages of development.

In the middle of December the mucous membrane was still reddened, but the mucus contained full-grown epithelial cells; the treatment was stopped, and no gleet remained.

CASE IV.—*Superficial urethritis, with acute exacerbation of four months' standing. Local treatment for two months. Recovery.*

A., aged twenty-two, carpenter. When eighteen years old contracted gonorrhea; three years later, his second gonorrhea, which, after two months, left a gleet, which, several months later was complicated by an epididymitis and rheumatic pains in both femora. The gleet continued one year later in spite of all treatment. May, 1872, commenced treatment. Bougie No. 16 passed easily. Posterior half of the urethra was found to be diffusely reddened and dull. Sulphate of copper was applied twice a week. The discharge stopped after three weeks. In five weeks the redness visibly diminished and the rheumatic pains stopped. After two months the patient was discharged cured.

The treatment of superficial urethritis continues usually two months, and consists in the local application of sulphate of copper alone, or accompanied by injections of sulphate of zinc. The diet is only restricted against too much beer or liquor.

Fürstenheim describes a superficial urethritis with one or several reddened patches, with healthy membrane between them. He found this after excessive use of tobacco, excessive venery, and inappropriate injections, and they disappeared only when the cause was withdrawn.

2. *The Parenchymatous or Hyperplastic Local Urethritis.*—This is, in most cases, a consequence of an acute, virulent gonorrhea, but may* set

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* Tarnowsky.

in without an acute initial stage, and thus, from the first, appear as a gleet. Inflammation from the first is more limited than in the preceding variety, and we most frequently find it in the bulbomembranous portion, to the extent of 1, 2, and rarely 5 cm. in length. The mucous membrane is deeply reddened, velvety, swollen, and rather sharply defined from the surrounding parts. The diseased part is tender and swollen, and consequently the canal is a little retracted. The swelling is caused thereby, and is not limited to the mucous membrane, but reaches the submucous tissue, which here is a kind of cavernous tissue, with only smaller cavities than are found in the corpora cavernosa or the corpus spongiosum.

We usually succeed, in the course of one or two weeks, by means of bougies Nos. 10 to 18, in dilating the constricted part so that the endoscopic tube will pass through. Under the local treatment the redness and swelling will disappear, so that after a time the tube will pass without resistance.

As to the frequency and the portion of the urethral canal affected by this form, Fürstenheim's and my own experience differ from Desormeaux's. Desormeaux saw this variety much more rarely than the granular, and he is of the opinion that both of these varieties exist only in one portion of the urethra at one time, and this always in the posterior part. Fürstenheim and myself consider this variety as more common than the granular, and we have often found it in two different parts of the urethra at the same time. I have seen several times, besides the membranous portion, a part of the urethra just behind the fossa navicularis anterior affected simultaneously.

This variety may lead to stricture, and it is a well-known fact that strictures are found most frequently in the posterior portion, but may also appear in the anterior portion of the urethra. The treatment is here the same as in the foregoing variety, but requires a longer time.

CASE V.—*Parenchymatous urethritis of three months' standing. Local treatment for three months. Recovery.*

N., aged twenty-three, officer in the army, pale, but strongly built, came under treatment November 5, 1871. In the winter of 1869 had an acute gonorrhea which lasted four months. August, 1871, had another gonorrhea, which, after seven weeks' treatment, left a gleet—blennorrhea—that has continued ever since. Now, bougie No. 8 showed a stricture and a tender place in the membranous portion. After ten days of bougie treatment No. 18 passed readily. The endoscope showed that the mucous membrane in the bulbomembranous part was swollen, red, and velvety. This part was touched with sulphate of copper twice weekly. A month later had an epididymitis which lasted fourteen days, during which time local treatment was suspended. After three months' treatment the discharge ceased, the mucous membrane became smooth, less sensitive, and paler, and a specimen of the mucus removed from the spot contained only epithelial cells. A year later there was no relapse. Another case of this variety will be reported under the head of Gonorrheal Rheumatism.*

This parenchymatous urethritis is more persistent than the previous variety, and the treatment lasts from three to six months.

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* See also Dr. Hinde's case.

According to Fürstenheim, stricture follows this variety as frequently as Desormeaux's granular urethritis.

CASE VI.*—*Parenchymatous urethritis.*

J. C., aged nineteen, variously employed, healthy male, had first gonorrhea three years ago, for which he commenced treatment, but discontinued the same, and the discharge lasted ten to eleven months. During the gonorrhea he had a bubo, which suppurated and discharged, and six weeks later the wound closed. Soon after the bubo disappeared the discharge ceased spontaneously. One year and a half ago contracted second gonorrhea, for which he used injections, and was cured six weeks later.

During the second week of November, 1879, he suffered from his third gonorrhea; commenced treatment after two weeks, using the same injection as cured previous attack, and began to improve, but after using one bottle he lost the prescription and changed to another, which failed to cure. He now used other injections and took internal treatment for two months, with like results. The discharge continued, and about March 1, 1880, he presented himself for treatment. At this date he suffered from a thin, gleety discharge, with constrictions of the urethra at two places. Steel sounds were employed weekly, which produced pain on their passage. Injections of fluidextract of hydrastis canadensis (1 : 8) were used three times daily. He continued under the above for six weeks with no apparent benefit, but at this period suffered from epididymitis and swelled testicle. These complications now received attention, with complete suspension of foregoing treatment for the gleet. The swelling of the testicle passed off in about two weeks.

On May 1st an examination was made of the urethra per endoscope, and a general injection of the canal in its entire length was noticed. At two points, viz., the bulbomembranous junction and at a place situated at about one inch from the meatus urinarius, there were slight contraction, thickening of the mucous membrane, marked redness, and a dull, velvety appearance. The posterior diseased patch commenced at a distance of six inches from the meatus urinarius and extended forward one and a half inches; the other diseased portion was found one inch and three-fourths from the meatus, and reached forward three-fourths of an inch. There was an abundant mucopurulent discharge throughout the urethra, which, under the microscope showed numerous pus-cells. This discharge was most marked at the above two patches. He complained of pain on passing the instrument, and the latter detected two constricted portions situated at the above-described patches. An application through the tube, after swabbing the urethra with dry cotton, of the solid sulphate of copper was now made to the diseased portion, and an injection of hydrastis canadensis was ordered to be used three times daily, and he was asked to return for local treatment every third day. Beer, coffee, and coitus were interdicted.

During May he made an irregular attendance of six times, and at the end of this period the discharge had markedly lessened. During the first two weeks of June he appeared three times, when the discharge ceased, after which he failed to come, but continued to use the injection for two weeks, when the discharge returned and he once more appeared.

July 1st: After two or three applications the discharge again ceased, and after a week's stoppage without local treatment it again recurred. This recurrence, however, consisted in a more copious and more purulent discharge than was present at the commencement of treatment. The patient, upon being closely questioned, stated that a day or two before he had been sexually excited but had avoided coitus.

August 1st: The discharge has rapidly subsided, so that there is now no staining of the shirt, but still noticeable is the gluing together of the meatus each morning.

The injection was now changed to one of fluidextract of hydrastis canadensis and dilute liquor plumbi subacetatis.

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* Dr. Hinde's case.

The visual endoscopic examination, August 1st, revealed the innermost patch much less injected, less velvety, and less swollen. The anterior patch, greatly lessened, is the paler of the two, but, singularly enough, is covered with a greater quantity of discharge. He experiences slight pain when the tube is passed over the second patch only.

August 10th: No discharge at meatus visible, but the patient states that the latter is glued together each morning. Up to this date no regularity of application has been carried out, but about six times a month has been the attendance. At this date was ascertained the fact that the patient has been in the habit of evacuating the contents of his bladder immediately after each treatment. He was now asked to urinate before appearing for treatment, and to come at shorter intervals and more regularly. For three or four times he appeared at intervals of two days and continued his injections regularly. At this time he made more marked improvement than at any previous period of his treatment. He said he felt much better; the gluing of the meatus passed away; the endoscopic tube passed more easily and ceased to cause pain, and the application of the caustic became less and less noticeable to the sensations of the patient.

Under date of September 13th my notes show that the discharge has been stopped for three weeks. Endoscopic examination disclosed no constriction of the canal nor pain on passing the tube; the patches have disappeared, and the mucous membrane is pale and reflecting. A very scanty discharge is with difficulty removed from the mucous membrane by means of a probe, and the same, on examination under the microscope, is found to contain no pus-cells, but only epithelial cells in various stages of development from a nucleus to a fully formed cell.

September 19th: Still no discharge; treatment continued; no pus-cells on microscopic examination of mucus covering membrane; confesses to coition twice since last date.

October 5th: No discharge and patient feels "first class."

In closing I may mention that there is but slight pain produced on the application of the caustic, and this lasts but a few minutes.

I have found it necessary, after marking out the diseased portions at the first sitting, to make a visual examination of the urethra once in two weeks only. In the early part of the treatment, on the morning after each application, the discharge was increased, but on each succeeding day it steadily lessened up to the following application.

R. H. Bartlett and myself have several cases of gleet progressing favorably under the above treatment, which will be reported at a subsequent date.

3. Granular Urethritis.—This variety has the same situation as the preceding, from which it does not differ essentially either in its course or its sequelæ.

When the ophthalmologists, in an organ so easily examined as the eye, can see and examine the granulations and inflammations with such differences as we find they do in the literature of recent years, it is little to be wondered at that the granular urethritis has not been more distinctly and clearly described. This deficiency in our knowledge of the true anatomic character of the disease is of a more scientific than practical value, on account of the diagnosis being easy and the treatment of the different varieties identical.

We find, in the posterior part of the urethra, the bulbomembranous part, or, anteriorly, immediately behind the fossa navicularis anterior, a portion, of from 1 to 3 cm. in length, where the bougie is impeded, and where it produces some pain, and where the endoscope shows us one of the following varieties of granulations:

(*a*) *Small, Dark-red Granulations.*—Upon the injected, swollen, velvety mucous membrane we see numerous very small, point-like, protruding, dark-red projections. Usually they do not bleed when the tube is inserted or when they are touched with sulphate of copper.

(*b*) *Large, Round, Red Granulations.*—The diseased surface looks like the granulating surface of a wound, with lighter or darker red, round and soft granulations, from the size of a pin's head to a millet-seed. They bleed readily, even on the slightest touch. They are situated either close to each other or more widely spread over the granulating surface. Desormeaux describes the color either as a lightish or a darker red.

Most likely there is only a slight difference in degree between the hyperplastic urethritis and the two last-named varieties of granulations, because these varieties can be seen to be present in one and the same urethra.

(*c*) *Small Gray or Yellowish-gray Granulations.*—These have the same appearance as the acute granulations in the conjunctiva palpebrarum, but are rarely met with in the urethra. Desormeaux and Tarnowsky regard them as the least frequent variety. It is at present undecided whether they are a separate variety, or merely a stage of development between the hyperplastic and the other granular varieties.

The granular urethritis, whether it shows itself in one or the other of the above-named varieties, is similar to one and the same disease of the conjunctiva, in so far that in the course of months or years it destroys the mucous membrane, which is transformed into cicatricial tissue, and results in stricture, the firmness and narrowness of which are greater in the same proportion as the inflammation has passed beyond the mucous membrane and involved the surrounding cavernous tissue. This termination of the granular urethritis Tarnowsky has been able to follow directly in the external orifice of the urethra in prostitutes, of whom he has had charge for years in his hospital. He noticed that in the course of a year or more the granulations became paler, the wall of the urethra hard or cicatricial, and the orifice retracted.

On the other hand, Desormeaux has seen granular urethritis exist for ten, and in one case for forty, years without resulting in stricture, and similarly have we seen ocular granulations exist for many years without causing entropion.

But what termination a case of granular urethritis will take—how soon a stricture will be formed—we cannot decide as yet, and for this reason alone it is important, even if the disease does not involve other dangers for the patient, as acute exacerbations, epididymitis, gonorrheal rheumatism, infection of healthy women by coitus, etc., to try to cure the disease by every means in our power. It is then a local treatment in these cases that is indispensable and our mainstay, though it needs to be supplemented by the commoner methods, diet, etc.

The necessity of local treatment was recognized before the invention of the endoscope, and Lallemand's porte-caustique drew forth a marked show of attention. As there is almost always some constriction, the endoscope cannot be used until dilatation per bougie every one or two days for a period of one to two weeks will permit the tube to be passed.

If the granulating surface is too resistant, Cruise introduces the tube as far as the seat of stricture, and then cauterizes until the swelling has subsided by degrees, commencing at the most external or anterior point. By this method longer time is needed for the complete application to the diseased surface than by bougie dilatation from the very commencement. Sometimes the meatus urinarius is normally narrow, in which case Fürstenheim dilates with the knife. As soon as we make application to the entire diseased surface per endoscope we commence the use of local astringents. Desormeaux brushes every second or fourth day with a solution of nitrate of silver, 1 : 1 or 1 : 3. He holds that nitrate of silver in substance acts too strongly, except on fungous, easily bleeding, and old granulations. He gives a warm bath after each application, and between applications the patient uses weak injections of sulphate of zinc. As far as the diet is concerned, he prohibits only the use of beer and coffee. Tarnowsky uses a weaker solution of nitrate of silver, 1 : 12, every two days, but besides this he cauterizes with sulphate of copper or nitrate of silver in substance. Cruise brushes with nitrate of silver every four or five days, sometimes interrupted by the application of the solid nitrate of silver. For the use of the latter he takes an applicator or stilet, the outer end of which he coats with fused nitrate of silver. Fürstenheim brushes with a weaker solution of nitrate of silver, but uses the sound more frequently, viz., every day, and allows the patient himself to use injections of cold water and take cold sitz-baths. I have generally applied the solid sulphate of copper every two or three days. The pain with this application is very slight, and not to compare with the same application to the conjunctiva. On one occasion I lost a piece of sulphate of copper in the urethra, and it was evacuated some minutes later on urinating without having caused any noticeable irritation.

Less frequently I have used diluted nitrate of silver, viz., the mixture of pure crystals and the chlorid of silver, which makes a good, firm, infriable mass. It acts much more strongly than the sulphate of copper, and causes, especially in the more superficial forms of the inflammation, symptoms of irritation with augmented discharge, but on the soft, easily bleeding granulations it is quicker and better than the copper.* Generally, we have our patients use weak injections of sulphate of zinc. Any particular diet cannot be enforced, because the treatment extends over too long a period. I usually permit a little coffee and claret, but no whisky or beer; besides, they need good nourishing food, and iron if anemic, and only very rarely, when there is an acute exacerbation of the urethritis, a little copaiba is permissible. Cold baths in summer and sitz-baths will be found accessory.

The duration of the disease under this treatment is variable. Desormeaux claims to cure all these cases during a treatment of two to three years. The remaining authors claim to cure somewhat more quickly, and according to their and my own experience a cure may be effected in from two to six months. A treatment extending over so long a period and requiring so frequent applications would be a source of great labor to the practising physician if it were necessary upon each application to explore and visually examine the diseased portion of the urethra; but this is now unnecessary, as an improvement on my instrument has been recently invented by Dr. Alfred Hinde,* of Chicago, which consists of a graduation of the tube in inches or centimeters, commencing from the inner end and situated on the external surface of the instrument. By this improvement, at the first sitting, after a careful inspection, the diseased portion can be mapped out in inches or centimeters from the meatus, thus rendering a visual examination necessary once in two weeks only. Consequently, for the daily application, we have only to introduce the tube to the inner extremity of the diseased portion, withdraw the plug, introduce the applicator just beyond the tube, slowly withdraw both simultaneously until we reach the outer extremity of the diseased portion. We now withdraw the applicator within the tube, and thus protect the normal mucous membrane from the caustic, and remove both at leisure. It is unnecessary to state that upon the withdrawal the walls of the urethra fall together as the instrument retreats, and in so doing grasp the solid caustic that extends beyond the tube, and thus receive a thorough application.

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* See Case VIII.

Concerning the question of permitting coitus during treatment, Tarnowsky differs from authors generally in permitting moderate and regular cohabitation, but not promiscuously. Ordinary sexual excitement tends to prolong or continue the inflammatory condition of the urethra upon which the gleet depends, even if the exacerbation of the latter be not produced, which latter is a frequent result in our experience. Another important reason for prohibiting sexual intercourse is the danger to which the second person is exposed of catching either an acute gonorrhea or a gleet from the commencement, dependent upon the granular inflammation of the os uteri.

We consider it the duty of every physician to warn his patient against every act that is likely to prolong the disease or interfere with the progress of treatment, especially mentioning coitus. Even sexual excitement without coitus, noticed in Dr. Hinde's case as being sufficient to excite an exacerbation which might nullify several weeks of previous treatment, should be strictly forbidden. That a perfect recovery has taken place and we may safely stop the treatment is shown, not by the apparent cessation of the discharge, because this frequently fails to reach the meatus when in small quantity, even while granulations exist, yet on internal examination there is a slight whitish covering over the diseased portion of the mucous membrane. But perfect recovery is warranted:

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* Dr. Hinde's instrument was made by Mr. R. M. Johnson, manufacturing jeweler, 229 W. Madison Street, corner of Peoria Street, Chicago, and cost, together with the applicator and forceps, $6.00.

(*a*) When the swelling has entirely disappeared; when on introducing the tube no resistance in the diseased portion is noticeable.

(*b*) When the mucous membrane now is smooth and reflecting and has lost its previous velvety appearance.

(*c*) When the mucous matter from the formerly diseased part after the removal upon a probe, etc., is shown under the microscope to contain no pus-cells, but only partially or fully developed epithelial cells, which are readily recognized by their large, sharply defined, oval nuclei. A slight redness may still continue for some time, and Desormeaux advises the continuance of urethral injections for some time.

4. The Herpetic Urethritis.—The herpetic phlyctenular urethritis is a benignant and superficial form of inflammation, is rarely seen, but when found, is most frequently met with in pale, scrofulous adolescents. Slightly irritable symptoms are alone complained of, and through the endoscope we notice small red and flattened spots, irregularly spread through the canal, or yellowish, round erosions with a reddened areola. Simultaneously we frequently find patients suffering from herpes præputialis. No constriction or tenderness is perceived on the introduction of bougie or tube. The disease is cured either by dieting, with mild injections, or after a few mild, local applications.

5. Condylomata.—These are rarely seen, and extend only to a few lines within the external orifice, and very rarely are they found in the deeper portions of the urethra.

6. Polypi.—Polypi are also very rarely met with. They may be single or multiple. Tarnowsky has two diagrams of multiple polypi in the prostatic portion.

7. Primary Syphilitic Ulcers.—These will almost always be found within the fossa navicularis anterior, and will never present any difficulties of diagnosis.

8. Secondary Syphilitic Symptoms.—These are very rarely met with in the urethra. Tarnowsky found, during a postmortem examination on a child aged three years, scattered mucous patches in the urethra and bladder.

Divisions 5, 6, 7, and 8 we shall not discuss, as they are foreign to our subject.

Before entering upon the subject of gonorrheal rheumatism, we may state, respecting endoscopy, that we do not wish it to be understood that we desire to do away with the usual methods of treatment in simple cases of gonorrhea, but desire to recommend the local treatment in those cases that fail of cure by the ordinary methods, and in so doing we merely indorse the opinions of the most experienced endoscopists.

III. Gonorrheal Rheumatism

Ever since Monteggia, at the close of the last century, pointed out the connection between gonorrhea and rheumatism, and proved gonorrheal rheumatism to be a distinct form of rheumatic disease, there has been a dispute as to whether there is any relationship between the two diseases.

Those who oppose the idea of relationship between the two diseases have always been in a minority, and even if we find such names as Thiry and Tarnowsky among them, we must admit that the said relationship is now generally established.

Fortunately, it is a rare complication of gonorrhea, and it is this infrequency that proves the foundation of the main argument against it. The opposition claim that the 2 to 4 per cent. of rheumatism found as a complication of gonorrhea is no greater than the percentage of rheumatic cases found in adult males in general. Yet when we, by close observation, examine the development and course of the disease, we find a marked connection between the two. Thus we always find in persons suffering from gonorrheal rheumatism that the occasional causes, whether the disease is present for the first time or as a recurrent attack, are always either an acute gonorrhea or an exacerbation of gleet, and, on the other hand, the atmospheric and telluric conditions, that play so conspicuous a rôle in the ordinary rheumatism, are hardly ever mentioned by these patients.

This rheumatism, like the other variety, has its acute and chronic form, and it complicates or accompanies both the acute and chronic gonorrhea, but it is found most frequently associated with the latter.

The situation of the chronic urethritis is so far important that it seems to be a necessary condition for the development of the rheumatism that the posterior, the bulbomembranous, part of the urethra should be affected. Believing this, Ricord* and R. Bergh† claim to have prevented, by means of abortive injections, attacks of the disease in patients liable to gonorrheal rheumatism at each new invasion of gonorrhea. These authors claim that they prevent the rheumatism by limiting the urethritis to the anterior portion of the canal.

Experience has shown that catheterization of the sound urethra has caused rheumatic inflammation of the joints, and we can hardly imagine that other portions of the urethra can be damaged by the use of the catheter. Further, the gonorrhea always precedes the rheumatism, the shortest time being eight to ten days, and often months will elapse before the onset, at which time the inflammation will have reached the posterior part of the canal. Again, the rheumatism most frequently accompanies the gleet (Melchior Robert), the seat of which is always the posterior part of the urethra.

Brandes‡ found, in 65 cases of gonorrheal rheumatism, gleet in 51, an acute gonorrhea in 7, and in 7 cases it was impossible to ascertain whether the rheumatism had originated in an acute or a chronic gonorrhea. In 2 out of the 51 he found stricture, and in 5 cases, on digital pressure over the bulbous portion of the urethra, he detected a tender spot.

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* Melchior, Robert: Nouveau traite des maladies veneriennes, Paris, 1861, p. 246.

† Bidrag til Kundskab om Gonorre hos Mandfolk, Koebenhavn, 1860, p. 116.

‡ De rheumatismo gonorrhoico, in universum, et de forma ejus acuta, Hauniæ, 1848.

So far as the importance of the local chronic urethritis in the causation of rheumatism is concerned, Brandes has already pointed out that the local tenderness which is most frequently found 5 inches behind the meatus urinarius—consequently our parenchymatous and granular urethritis in the bulbomembranous portion—will be apt to cause, after the discharge is stopped and the rheumatism cured, an exacerbation of the discharge without any new infection, and a subsequent attack of rheumatism, due to excesses in drinking or venery. He relates a case in which all other remedies having been tried in vain for the cure of the rheumatism, recovery took place after cauterization with Lallemand's porte-caustique. The experience of more recent authors points in the same direction. R. Bergh tells us that the rheumatism most frequently appears during an exacerbation of the gleet. Ziess* says that the rheumatism most frequently does not show itself until the gonorrhea has become chronic, and that the chronic as well as the acute gonorrheal rheumatism will not disappear until the last traces of the gonorrhea have disappeared.

Following the suggestions of the foregoing authors, we tried the local treatment of the urethritis as accessory to the treatment of the gonorrheal rheumatism in the two following cases:

CASE VII.—*Synopsis. Polyarticular gonorrheal rheumatism accompanying the fifth gonorrhea. Three exacerbations in the course of two years, iritis, chronic parenchymatous urethritis in two places of the urethra. Local treatment for six months. Perfect recovery.*

O., aged thirty, sea-captain, came under treatment February, 1872. In his early years he had never suffered from rheumatism. From 1867 to 1870 he had four attacks of gonorrhea. In February, 1870, when in Singapore, which we would have it understood is in the tropics, where rheumatism is very rare, he had his fifth gonorrhea. After the discharge had lasted a couple of days he began to suffer from pain, redness, and swelling of both ankle-joints; the discharge stopped, but the pain and swelling in the joints increased. Three weeks later he visited a physician, who prescribed iodin locally and a mixture internally. In September he visited France, and the pain in the joints increased. In November he reached Copenhagen and entered the city hospital, and for three weeks was treated with steam baths, under which he partially recovered and went home, but continued the baths during the winter. In May, 1871, he could walk by means of a cane without much pain. Shortly afterward he had his sixth gonorrhea. The discharge ceased under copaiba and cubebs in ten to twelve days. Soon after he suffered from pain in both ankle-joints, left knee-, right shoulder-joint, and right metacarpophalangeal articulation of index-finger. He entered the Royal Hospital and was treated with steam baths, potassium iodid, together with other internal remedies. He left the hospital three months later without any improvement. The following four months he improved somewhat, so that he could walk about with a cane for an hour at a time. January, 1872, the scant discharge became more copious without any apparent cause, and a couple of days later the pain and swelling in the ankle-joints increased so that he could not walk at all. Eight days later pain and swelling set in in the metacarpophalangeal joints of the first, second, third, and fourth fingers of the right hand and the first and second fingers of the left hand.

In February, 1872, he came under the local treatment. On the first examination bougie No. 11 would pass, but there was resistance and tenderness in two places, viz., behind the fossa navicularis anterior and in the bulbous portion. In the course of a fortnight bougie No. 18 would pass. The endoscopic examination then showed, behind the fossa navicularis anterior, a part of the urethra 2 cm. in length, with the mucous membrane swollen, dark red, and velvety, and covered with a little whitish, puriform discharge. Behind this place the mucous membrane was healthy until the bulbomembranous portion was reached, where a similar patch, of from 2 to 3 cm. in length, was found.

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* Lehrbuch der Syphilis, Erlangen, 1871, p. 134.

The treatment consisted of steam baths and the local application of sulphate of copper every two days. During the first micturition succeeding the first application he felt some slight pain, and the next morning there was a drop of matter in the meatus urinarius, but on the second morning there was none. After the eighth application an increased swelling and tenderness was noticed in the anterior portion, and on this account the application was stopped and bougies were resorted to, from Nos. 12 to 16, which latter, in the course of two weeks, could be passed without pain. The local treatment was then continued for three months every second day, in the course of which time the condition of the joints became slowly ameliorated.

In May he had an iritis of the right eye, which subsided in four weeks under the usual treatment. At the end of June there was only left stiffness in the ankle-joints and in the right second and fourth, and the left first and second metacarpophalangeal joints. It was somewhat difficult for him to walk, on account of the stiffness of the ankle-joints, but there was no pain in them. He became easily tired, and then he felt pain in the planta pedis. In July and August he used cold sea-baths and local treatment to urethra twice a week, as the above-named patches in the urethral canal still continued to be reddish and some pus-cells were still present on their surfaces. In September the mucous membrane of the urethra was natural throughout, and the mucus contained only epithelial cells; the patient could now walk about the whole day and supervise the tackling of his vessel.

One year later: Has been married six months, and has had no rheumatism nor any urethral trouble since his recovery. In this case, consequently, the complete recovery lasted for one year, and the patient, who for two years was entirely out of employment, now is able to pursue his daily work.

Case VIII.—*Polyarticular gonorrheal rheumatism, commenced in a nine-months'-old gonorrhea. Yearly exacerbation of the rheumatism for twenty years. Iritides on both sides repeatedly. Chronic rheumatism for twenty years. Granular urethritis in bulbomembranous part. Parenchymatous urethritis behind the fossa navicularis anterior. Local treatment of the urethra for four months. Perfect cure of the urethra. Considerable improvement of the rheumatism, without any later exacerbation of the same.*

K., aged fifty, carpenter. Weak and anemic; early history free from rheumatism. In his twenty-second year (1845) contracted his first gonorrhea, which, in spite of treatment by injections and cubebs internally for three months, did not subside, but continued as a gleet, which, from time to time, was accompanied by an ardor urinæ. Nine months after the first appearance of the gonorrhea he had pain in both knee-joints, which subsided in two weeks. Two years later he acquired another acute gonorrhea, which left a scanty chronic discharge which has lasted ever since, with exacerbations from time to time.

The knee-joints again became painful and swollen, and in the following twenty years he had, almost every year, attacks of rheumatism commencing in the knee, extending later to the ankle-joints. These exacerbations came on at variable times each year, and entirely independent of cold or inclement weather, but always subsequent to an exacerbation of the urethritis, which most frequently appeared four to eight days previous to the rheumatism. From 1851 to 1863 he was married, and did not expose himself to any new infection, but had, nevertheless, frequent attacks of the disease. Eleven years ago, during a rheumatic attack, he had double iritis, new attacks of which set in with each yearly attack of the rheumatism, resulting finally in synechiæ, with opacity covering the pupillary field, on which account iridectomy was performed nine years ago on the right, and two years ago on the left, eye.

He entered the City Hospital August 12, 1871. On admission there was a considerable painless effusion in the right knee-joint, and pain and swelling in both ankle-joints. From the meatus urinarius a scanty white discharge could be pressed out.' For three months the usual antirheumatic and antigonorrheal treatments were used, without any relief.

October 15th: Bougie No. 13 was passed, and was resisted and caused pain behind the fossa navicularis anterior and at the bulbous portion. On succeeding days we introduced higher numbers, causing at times slight hemorrhage, and finally, October 29th, were enabled to make an endoscopic examination. In the bulbomembranous portion we found a patch 2 cm. in length, in which the mucous membrane was swollen and covered with round or oval, dark-red, easily bleeding granulations, of the size of a pinhead. Just behind the fossa navicularis anterior was a patch 1 cm. in length, in which the mucous membrane was dark red, bled easily, and was velvety, but had no whitish granulations. The residuum of the urethral mucous membrane was normal.

The diseased patches were treated every second day with sulphate of copper, which frequently caused a slight hemorrhage, and during the subsequent five or six hours the discharge of a thin, serous fluid.

November 1st: The urethral discharge is diminished.

November 4th: The rheumatic pains are more marked.

November 10th: Discharge very scant; swelling of the diseased portion somewhat diminished; no bleeding from posterior patch, but some from the anterior patch.

November 30th: Redness of patches diminished and mucous membrane smoother; a piece of the sulphate of copper broke off from the applicator and remained in the posterior part of the urethra until evacuated on the next micturition. He felt a little pain afterward in the anterior part of the urethra, but no further signs of irritation. The condition of the joints is slowly improving.

January 1, 1872: The patches still smoother, but yet dark red. The anterior patch is now so soft that there is no resistance on the passage of the endoscope. The sulphate of copper was now stopped, and dilute nitrate of silver was used every three days.

January 5th: For twenty-four hours after the application there has been pain on micturition, but no increase in the discharge.

January 20th: The mucous membrane and patches are now smooth and not swollen, but still darker red than normal; no discharge in any part of the urethra; the swelling in the knee- and ankle-joints has subsided, and there is only a slight stiffness left.

January 24th: Left the hospital.

During the subsequent four weeks applications of the sulphate of copper were made, whereupon the redness of the patches subsided and the mucous membrane of the urethra became generally healthy. The following four months he was quite well, except a little stiffness of the joints, and was able to attend to his business.

In such an inveterate case of rheumatism in an old and anemic individual we could not expect a more complete recovery, and it is already a great advantage that no subsequent exacerbations set in. It is natural to conclude that this favorable termination was due to the cure of the granular urethritis more than to the antirheumatic treatment, yet we should not advise entire reliance upon the one without resorting to the other. We will have to combat the rheumatism by every means in our power, but we hold that the chronic local urethritis has been and still is too little noticed in the treatment of gonorrheal rheumatism, and we claim that the proper treatment and cure of the urethritis is a *conditio sine qua non* for the complete recovery from the rheumatism.

TRICHINOSIS—REPORT OF TWO CASES *

In reporting the following cases of trichinosis it is not my intention to enter into an exhaustive discussion of the disease, nor do I claim to add anything to what is already known and to be found in the literature on the subject. But as cases of this disease are far from uncommon in this part of the country, and as opinions in regard to the treatment of the disease differ widely, I publish the following two cases to enunciate my views on the subject:

Case I.—On November 27, 1880, H. C. Hansen, thirty-seven years of age, a plasterer and contractor living at 635 North Ashland Avenue, bought a smoked and sugar-cured ham, weighing 9⅓ pounds, of a butcher on Milwaukee Avenue. On the next day, November 28th, at 6 o'clock in the evening, the whole family partook freely of the ham, which was sliced and eaten raw. Hansen ate from 2 to 4 ounces, or, as he expressed it, in all about as much as twice the size of his thumb. The next day, November, 29th, he ate some more of the ham. November 30th he went out to work as usual, but about 3 o'clock in the afternoon complained of severe pain in the stomach, together with diarrhea. To relieve this he took two drinks of bitters,—whisky and horehound,—which he says eased the pain, and he went to work again. December 1st the pain and diarrhea recurred more severely. December 2d the diarrhea became so painful that he was confined to his bed, the bowels moving about every ten or twenty minutes. December 4th I was sent for. On questioning Hansen and his wife in regard to what they had eaten they answered, as usual, that they had eaten nothing but ordinary food, the same that the children had had, and that they had not eaten raw meat. On December 6th, however, when asked directly if they had not eaten smoked ham, they acknowledged that they had. By this time they had eaten, boiled and raw, about 6 pounds of the ham. They asserted that the boiled meat was well done, and that they had eaten very little raw. I immediately took specimens from different parts of the ham, and, on microscopic examination, found it to contain numerous encapsulated muscle trichinæ, averaging about 30 to each grain of the meat.

The patient's temperature remained about the same—101° to 102° F.—until December 12th, when the whole family were removed to the house of a relative in order to obtain better nourishment and attendance.

December 13th, 9 A. M.: The temperature has not exceeded 102° F. at any time in the last twenty-four hours. The patient has diarrhea, movements of the bowels occurring every thirty to sixty minutes, and has considerable pain in the left arm. He drinks port wine, beer, cognac, etc. Between 8 P. M. and 3 A. M. he ate an omelet, soft-boiled eggs, veal steak, and drank three bottles of beer and a considerable quantity of milk. He can at no time sleep more than a few minutes, and his sleep is uneasy. 12 NOON: Pulse, 90; temperature, normal; he suffers excruciating pain in the muscles of the arms and legs. 1 P. M.: Pulse, 88; temperature, 100° F.; has a good appetite, but considerable muscular pain. 3 P. M.: Pulse, 84; temperature, 100.5° F. 6 P. M.: Pulse, 90; temperature, 102.5° F.; he has vomited considerably and has no appetite. 7.30 P. M.: The patient is almost prostrated from the nervous shock and terrible muscular pain. 9.30 P. M.: Pulse, 90; temperature, 101.5° F.; he has eaten soup with rice with good appetite. 10.30 P. M.:

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* Chicago Med. Review, 1881, vol. iii, p. 208.

Pulse, 80; temperature, 101.2° F.; prescribed morphin syrup; he seems in good condition, but still feels pain.

December 14th, 1.30 A. M.: Pulse, 70; the patient could not endure the pain, so a hypodermic injection of morphin was given him. 9 A. M.: Temperature, 99° F. 12 NOON: Pulse, 70; temperature, 100.5° F.; he is resting easily and sleeps. 3 P. M.: Pulse, 90; temperature, 101.5° F.; he is suffering intense pain. 5 P. M.: Pulse, 78; temperature, 103° F.; complains of pain in the side. 6 P. M.: Pulse, 90; temperature, 103.5° F.; ate a plate of soup and drank a glass of beer. 8 P. M.: Pulse, 80; temperature, 103.5° F. 11 P. M.: Pulse, 88; temperature, 103.2° F. 12 MIDNIGHT: pulse, 80; temperature, 102.5° F.; sleeps and has little pain.

December 15th, 8 A. M.: Pulse, 78; temperature, 100° F.; slept fairly well since midnight. 2 P. M.: Pulse, 86; temperature, 101.5° F. 4.45 P. M.: Pulse, 94; temperature, 102.5° F.; feels easy when he does not move. 7 P. M.: Pulse, 94; temperature, 102.3° F.; suffers excruciating pain all over the body. 10 P. M.: Pulse, 90; temperature, 104.2° F.; the pain still continues.

December 16th, 9.30 A. M.: Pulse, 88; temperature, 100° F.; the patient has rested easily since 2 o'clock this morning. Until 2 o'clock he had a passage every half-hour. Since 7 A. M. he has had only two passages. There is pain on pressure all over the muscles of the arms and legs. He suffers no pain when he remains absolutely immobile in bed, but the slightest active movement causes pain in the muscles thus brought into action. He has had four or five glasses of beer this morning. The pulse is soft and weak. 2.45 P. M.: Pulse, 90; temperature, 101.5° F.; feels weak, but is otherwise comfortable. 5 P. M.: Pulse, 90; temperature, 101.5° F. 7 P. M.: he vomited and felt weak afterward. 9.15 P. M.: Pulse, 100; temperature, 102.5° F. 11 P. M.: Pulse, 84; temperature, 102.2° F.; the patient feels well.

December 17th, 9 A. M.: Pulse, 84; temperature, 99.7° F. 5.15 P. M.: Pulse, 84; temperature, 100° F. 10 P. M.: Pulse, 84; temperature, 101° F.

December 18th, 9 A. M.: Pulse, 74, full and strong; temperature, 99.5° F. 10 P. M.: Pulse, 80; temperature, 101° F.; all going well.

December 19th, 10.30 A. M.: Pulse, 70. 11 P. M.: Pulse, 88; temperature, 100° F.

December 20th, 9 P. M.: Pulse, 86; temperature, 99.5° F.

December 21st, 8.30 A. M.: Pulse, 76; temperature, 99° F. 9 P. M.: Pulse, 106; temperature, 100° F.

December 22d, 9 A. M.: Pulse, 90; temperature, 99.5° F. 9 P. M.: Pulse, 96; temperature, 100.5° F.; the patient suffers some pain on pressure over the epigastrium; feels generally weak; there are stiffness and weakness in the extremities and pain upon motion.

December 24th, 10 P. M.: Pulse, 100, weak; considerable edema around both ankle-joints, and extending almost to the knees; no pain when the patient remains immobile.

December 25th, 10 P. M.: Pulse, 104.

December 30th: The patient's left leg is cold, and he cannot get it warm, even by the stove.

December 31st: Temperature normal; from 10 o'clock last night until morning he experienced a very unusual degree of heat in both legs, so that he could not bear to have them covered at all. He actually suffered from heat, but experienced no itching sensation.

From this time on the patient's pulse and temperature remained normal. The diarrhea lessened gradually, and ceased in about two weeks. About the middle of January, 1881, he was able to sit up.

January 15th: Appetite good; sleeps well; pulse and temperature normal; no diarrhea; looks pale and emaciated; the patient gets tired after walking a few steps; has edema of the legs in the evening, which disappears in the morning; there is no pain on pressure of the muscles.

With a harpoon I took out of the right gastrocnemius muscle about a cubic millimeter of muscular tissue. On microscopic examination this was found to contain three living muscle trichinæ, one of which was rolled up in a spiral and apparently about to become encapsulated. The two others were free. Whether the two latter were torn out of newly formed capsules or were not yet encapsulated I was unable to determine. For the next two months the patient was very weak and pale. Muscular strength returned very slowly, so that it was not until March, more than three months after the inception of the disease, that he was able to walk about the whole day and think of recommencing work, and even now, about five months after the infection with trichinæ, he has not entirely regained his strength.

CASE II.—Mathilde Hansen, wife of the last patient, thirty-six years of age, was attacked by the same symptoms, in a more aggravated form, four days after her husband began to feel the effects of the infection. She partook of the ham at the same time, and says that in all she ate three thin slices of the raw, and possibly two pounds of the boiled, meat, selecting the meat nearest the bone.

December 12th, 2 P. M.: Pulse, 130; temperature, 106° F. 5 P. M.: Pulse, 130; temperature, 105° F.; has no pain and is cheerful; ordered 5 grains quinin every four hours. 6 P. M.: Pulse, 126; temperature, 103.5° F.; complains of pain behind the sternum; cannot get breath, and hands and feet are cold. 8 P. M.: Pulse, 120; temperature, 104.2° F.; has the desire to vomit but cannot; suffers intense pain. 9.45 P. M.: Pulse, 116; temperature, 103.5° F.; much pain and vomiting. 11 P. M.: Pulse, 112; temperature, 102.5° F.; intense pain.

December 13th, 1 A. M.: Pulse, 102; temperature, 104.5° F.; vomiting and pain. 2.30 A. M.: Pulse, 100; temperature, 103.5° F.; hypodermic injection of morphin was given, after which the patient felt more comfortable and slept a little. 6.30 A. M.: Pulse, 100; temperature, 103° F.; feels more easy; ordered digitalis and laudanum and the application of an ice-bag to the pit of the stomach. 8.30 A. M.: Pulse, 100; temperature, 102° F., administered wine and cognac. 9.30 A. M.: Pulse, 98; temperature, 101° F.; vomiting; the wine and cognac continued. 11.30 A. M.: Pulse, 96; temperature, 101° F.; feels easy, but vomits; continued wine and cognac. 1 P. M.: Pulse, 90; temperature, 99° F.; appetite is returning slowly; Liebig's extract of meat was given. 3 P. M.: Pulse, 96; temperature, 100.5° F.; considerable vomiting. 6 P. M.: Pulse, 90; temperature, 101.2° F.; vomiting and pain. 9 P. M.: Pulse, 90; temperature, 100.5° F.; pain in the stomach; morphin syrup was ordered. 10 P. M.: Pulse, 90; temperature, 100.5° F.; the pain continued and the morphin was again administered.

December 14th, 1.25 A. M.: Pulse, 80; temperature, 100.2° F.; cannot sleep, but seems to have less pain. 6 A. M.: Pulse, 80; temperature, 100.4° F. 8.30 A. M.: Pulse, 90; temperature, 99.9° F.; has slept a little. 12 NOON: Pulse, 94; temperature, 99.9° F.; sleeps and rests easily. 5 P. M.: Pulse, 84; temperature, 100° F.; feels comfortable; has eaten boiled flounder with apparent relish. 9.30 P. M.: Pulse, 96; temperature, 100.2° F.; complains of pain.

December 15th, 8 A. M.: Pulse, 84; temperature, 97.5° F.; very weak and does not sleep. 9 A. M.: Pulse, 84; temperature, 98.2° F.; says she "can't feel" her legs. 2 P. M.: Pulse, 98; temperature, 99° F.; there is constant formication in all the muscles. 4.30 P. M.: Pulse, 100; temperature, 98° F.; formication with a great deal of heat over the whole body. 7 P. M.: Pulse, 90; temperature, 99.5° F. 10 P. M.: Pulse, 94; temperature normal.

December 16th, 7 A. M.: Pulse, 98; temperature, 99.5° F.; has drunk a bottle of champagne since 10 o'clock last night and has slept a little. During the night she had passages from the bowels with tenesmus five or six times every hour. 12 NOON: Pulse, 100, and very weak. The patient has had three or four passages since 7 o'clock this morning, at which time she had slight formication around the extremities, especially in the legs, which felt stiff. She has no pain, but appears very weak and debilitated. She is extremely nervous, and cannot endure the least noise. Her sleep is interrupted, and she can doze off for only half an hour at a time. She has had coffee, fish, and beef-tea. 2.30 P. M.: Pulse, 96; very weak; temperature, 98.2° F.; the extremities are cold; laudanum and wine were ordered. 5 P. M.: Pulse, 100; temperature, 100° F. 6.15 P. M.: Pulse, 120; temperature, 99.9° F.; has had three movements of the bowels since 5 o'clock. 11 P. M.: Pulse, 94; temperature, 100° F.; sleepy and feels comfortable.

December 17th, 9 A. M.: Pulse, 92; temperature, 97.5° F.; her voice is very weak and she feels weaker than yesterday. She was able, however, to walk out to the closet five or six times during the night. 5.30 P. M.: Pulse, 108; temperature, 100° F. 10 P. M.: Pulse, 112; temperature, 102° F.

December 18th, 9 A. M.: Pulse, 96, very weak and soft; temperature, 98° F.; she had five movements of the bowels during the night. 4.30 P. M.: Pulse, 104; temperature, 98° F.; excessive vomiting and diarrhea, but eats well. 10 P. M.: Pulse, 106; temperature, 98.2° F.; patient comfortable.

December 19th, 8 A. M.: Pulse, 96; slept from midnight until 6 o'clock this morning. 11 P. M.: Pulse, 102; temperature, 99.5° F.

December 20th, 9 A. M.: Pulse, 102; temperature, 99.2° F.

December 21st, 8.30 A. M.: Pulse, 108; temperature, 98.5° F.; ordered tincture of digitalis, 10 drops. 9 P. M.: Pulse, 106; temperature, 100° F.

December 22d, 9 A. M.: Pulse, 108; temperature, 98.5° F. 9 P. M.: Pulse, 100; temperature, 99.7° F.; no pain; difficult respiration; weak; has slight cough; heart-sounds normal; no râles to be heard in the lungs. There is stiffness, but not pain, on moving the lower extremities. Has had three to five half liquid stools.

December 24th, 10 P. M.: Pulse, 108, weak and soft; complains of pain in the breast; no movement of the bowels since 5 o'clock this morning.

December 25th: Pulse soft and very weak. The patient is very weak and can stand only for a few minutes at a time. 10 P. M.: Pulse, 102, weak; temperature normal. Four liquid stools in the past twenty-four hours.

After this time there was no further rise in temperature. The stools were still liquid until about the middle of January, 1881. The patient gradually became stronger, and was able to be up and about the house about the end of January. Had no edema of the legs at any time. About the middle of February she was able to do her own housework, but became easily fatigued. She has now (April) regained her former state of health.

A remarkable feature in this case was the high temperature in the second week after the infection (as indicated by the accompanying chart, Fig. 29), which was so uncommon as to make me believe that some complication had set in, but failing to find any after careful examination of all the organs, I could not attribute it to any other cause than the trichinosis, and thought that I had a very severe case to deal with, which I expected would terminate fatally from collapse during the continuance of the extremely high temperature. After twenty-four hours, however, the temperature went down and did not rise again, and, contrary to my expectations, the patient recovered.

Three children of the above patients, girls, aged respectively fifteen, five, and two years, partook of the ham in question, both raw and after boiling, in quantities that cannot be ascertained, but no symptoms of the disease appeared in them at any time.

TREATMENT

The first question which presents itself in incipient cases of trichinosis is naturally whether it is possible, and if so in what way we may hope, to remove from the intestinal canal the full-grown and gravid female intestinal trichinæ and the newly born embryo muscle trichinæ, before they perforate the wall of the intestines and get out into the tissues.

If we were so fortunate as to know within a few hours after a meal of trichinous meat had been eaten that such had been eaten, we should, of course, administer emetics and strong purgatives, but this resource is practically out of the question, as the patients do not begin to have any distressing symptoms until a day or two after eating the diseased meat, and then, in most cases, several days will elapse before medical aid is sought, and it will probably take a day or two more for the physician to make up his mind as to the diagnosis.

If the diagnosis can be made in the first week of the disease, in cases in which there has been no diarrhea, we should not hesitate to give laxatives and keep up frequent and liquid stools for some time. But in most of the cases the first stage of the disease is, as it was in the above-mentioned cases, characterized by a violent diarrhea, caused by the emigration of the embryo muscle trichinæ through the intestinal walls.

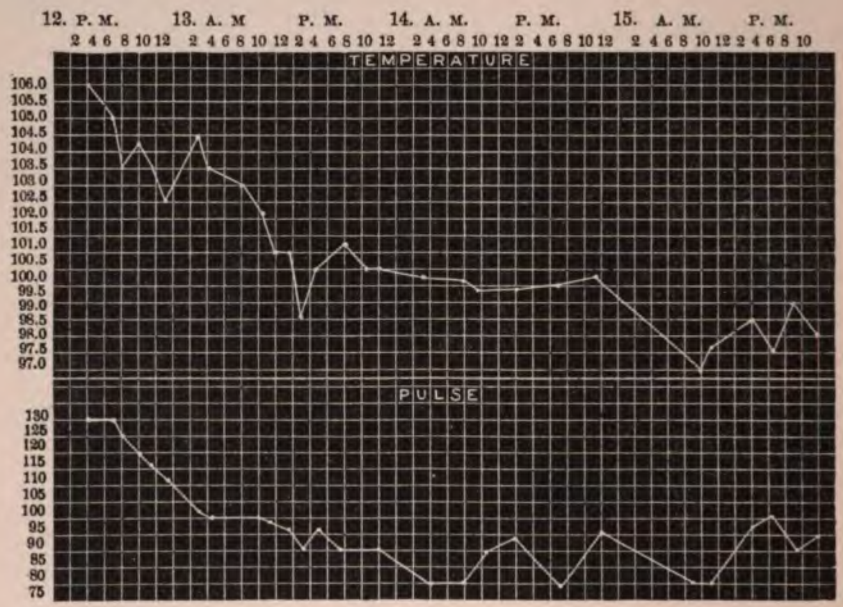

Fig. 29.—Chart. December, 1880.

When, therefore, as in these cases, liquid stools are as frequent as from 10 to 20 in the twenty-four hours, it seems to me that purgatives are not only unnecessary, but are even contraindicated, for the following reasons: We know that we have to do with a disease which will last for a long time and greatly debilitate the patient. To obviate this inevitable debilitation, the only remedy in our power is a nourishing and roborating treatment. Purgatives would tend only to diminish or do away with what might have remained of the assimilating power of the upper parts of the intestines, and I consequently abandon them altogether in such cases, permitting the patients to have a full, nourishing, but at the same time easily digested diet, and as much as they wish. Milk was used steadily as a drink; soup, eggs, beefsteak, fish, oysters, etc., were also freely used, and the amount limited only when vomiting prevented their use. Beer, wine, and whisky, *ad libitum*, for stimulation. Besides these, the medicines given were merely symptomatic, namely: quinin, when the temperature rose; digitalis, when the pulse exceeded 110; and morphin, hypodermically and *per orem*, to allay the pain.

As soon as the acute stage of the disease has passed and the patient has entered upon the slow stage of convalescence, the only medicines to be used, in addition to an invigorating diet and the moderate use of stimulants, are the ferruginous tonics.

NERVE-STRETCHING

WITH E. W. LEE, M.D.

THIS operation has been known for only about half a decade. It was originated accidentally by Billroth, who cut down upon the sciatic nerve, expecting to find a tumor, but found nothing but normal nerve tissue. By this very examination, however, the neuralgia was relieved. Nerve-stretching as a premeditated surgical operation was first carried out by von Nussbaum, in Munich.

The unexpected success in relieving pain by this operative procedure in cases in which all other remedies have failed, and the almost absolute immunity, not only from danger to the patient's life, but also from the destruction or impairment of the normal functions of the nerve operated upon, caused this operation to be very readily adopted by medical men all over the world.

There are already a number of facts at our disposal which throw considerable light upon the therapeutic value of the operation in certain diseases of the nerves.

As our knowledge of the subject is as yet very imperfect, owing to the scarcity of pathologicophysiologic experiments on animals, we shall here give only a brief account of the various nervous diseases in which nerve-stretching has been tried, and point out the results, as far as known, but shall not be able to state anything about either the pathologico-anatomic or the pathologicophysiologic side of the question.

From a merely clinical point of view, the different nervous diseases in which nerve-stretching has been tried are the following:

I. Neuralgic anomalies.
    1. Sciatica.
        (a) Rheumatic, idiopathic or primary.
        (b) Symptomatic or secondary.
    2. Prosopalgia, or neuralgia of the fifth pair.
    3. Intercostal neuralgia.
    4. Idiopathic neuralgias of other nerves.
    5. Neuralgias of the peripheral nerves caused by surgical lesions involving the nerve-trunks.

II. Spastic anomalies.
    1. Mimic spasm. Spasms of the seventh pair.
    2. Spasms of the accessory nerve of Willis.
    3. Spastic contractions of the nerves of the extremities.

III. Epilepsy.
IV. Paralysis.
V. Tetanus.
VI. Locomotor ataxia.
VII. Anesthetic leprosy.

I. Neuralgic Anomalies

1. Sciatica

(*a*) *Rheumatic, Idiopathic, or Primary Sciatica.*—We have had at our disposal reports of 10 cases of nerve-stretching in this disease, 8 of which were successful and 2 unsuccessful (Bernays).

Case 1.—(John Cheyne, Edinburgh, 1877.[1, 2]) A furnace-man, forty years of age, suffered for five years from pain and weakness in the right leg, which increased to such an extent that he became unable to walk. On April 19, 1877, the sciatic nerve was stretched. The nerve appeared perfectly normal. The operation was followed by perfect recovery.

Case 2.—(John Cheyne, Edinburgh, 1877.[1, 2]) A furnace-man, forty-one years of age, had suffered from sciatica of the left side for ten months. The sciatic nerve was exposed and stretched April 23, 1877. The nerve appeared to have undergone fatty degeneration, and large, tortuous veins were to be seen on its surface. The pain disappeared entirely, with the exception of a small place behind the great trochanter, where pressure still caused a little pain.

Case 3.—(Maag, Denmark, 1878.[3]) A girl, nineteen years old, suffered from sciatica of three months' standing. The nerve was stretched. The wound did not heal by first intention. Recovery.

Case 4.—(Patruban, Vienna, 1878.[4]) Sciatica. Stretching of the sciatic nerve, followed by great amelioration of the symptoms.

Case 5.—(Bernays, St. Louis, Missouri, 1878.[5]) A man had suffered for six or eight months from severe neuralgic pains on the outer aspect of the thigh. The sciatic nerve was stretched immediately above the knee. The pain was relieved for six days, but then returned. One and one-half inches of the peroneal and external saphenous nerves were excised. This operation was followed by entire relief of the pain, but the muscles remained paralyzed.

Case 6.—Dr. Bernays mentions another case, without giving particulars, in which nerve-stretching proved to be a complete failure.

Case 7.—(Hildebrandt, Neustadt-Magdeburg, 1880.[6]) A woman, thirty-two years of age, suffered from sciatica of the left side. The sciatic nerve was stretched in the popliteal space. The wound healed by first intention. The operation was followed by immediate relief, and the patient, after eight days, was able to do her own work.

Case 8.—(Esmarch, Kiel, 1880.[7]) Sciatica. Nerve-stretching. Recovery.

Case 9.—(Purdie, London, 1880.[8]) Severe sciatica of several months' standing in a miner. The sciatic nerve was stretched. The wound healed by first intention. Recovery.

Case 10.—(Fenger, Chicago, 1880.)

Synopsis.—Sciatica of one year's standing. Stretching of sciatic nerve between the great trochanter and the tuber ischii. Wound healed by suppuration in eight weeks. Cessation of pain in the leg. Temporary paralysis of the sphincter ani and anesthesia of anal region and posterior surface of both thighs. Recovery.

Mrs. H., thirty-five years of age, healthy, stout, has two healthy children, aged respectively seventeen and eighteen years. Her father suffered from sciatica of the left side at the age of forty-five, which lasted a year, confining him to his bed for six months, and finally disappeared after treatment by sea-baths. Her sister had sciatica at the age of thirty. Her father died of cancer of the liver at the age of fifty. Her mother is still living and healthy, with the exception of occasionally recurring muscular rheumatism.

In June, 1879, while crossing the Atlantic, Mrs. H. was seized with pain in the right side of the head, face, neck, and in the right arm. An ointment was applied, and the pain disappeared in two or three weeks.

November, 1879: The patient awoke one night with a sudden and violent pain in the right ankle, which she could trace to no inducing cause. She was obliged to keep her bed for eight days. Under the use of morphin and some ointment the pain lessened so that she was able to be up and about.

During the whole of the following winter she was able to walk the whole day long on level ground without pain, but when mounting stairs pain would set in, always at the same place, around the external malleolus, at which, however, no swelling nor other inflammatory symptoms were to be seen. Every night she would be awakened several times by vehement pain in the ankle, caused, as she thinks, by moving the leg during sleep. In this way it went on until June, 1880, when pain set in in the right knee and soon extended along the posterior part of the femur to the hip, so that she was not able to extend the leg at the knee, and could not walk without limping. When she got out of bed in the morning the pain was very severe, but would lessen after she had walked about a little. She would soon become tired and be obliged to sit down, and when she would start to walk again, the pain would be very severe. She was not able to walk more than about 2000 feet before the pain would become so intense as to compel her to sit down. Various kinds of internal medication, hypodermic injections of morphin, and Turkish baths were tried, but with no effect. The pain became worse, and she had more and more difficulty in walking, until she finally determined to have the proposed operation performed.

On October 6, 1880, Dr. Fenger, assisted by Drs. Jacobson and Koren, proceeded to stretch the right sciatic nerve. The patient was anesthetized with chloroform. An incision was made, 4 inches in length, between the great trochanter and the tuber ischii. The layer of adipose tissue was about 1 inch in thickness. The depth of the wound and the hemorrhage caused a little delay in finding the trunk of the nerve, which, when found, appeared normal. The nerve was now stretched vigorously, centrally as well as peripherally, and pressed between the fingers and the instrument with which the nerve was held out of the wound, namely, an elevator of the palpebræ used as a retractor. The wound was washed out with 2.5 per cent. solution of carbolic acid until the hemorrhage ceased. No drainage-tube was inserted. The wound was closed with antisepticized silk, and a Lister dressing applied.

The wound did not heal by first intention, but suppuration set in, which prevented it from healing for eight weeks, during which time the patient was obliged to remain in bed.

The pain in the thigh and knee ceased entirely and has not since returned, and the knee could be fully extended without pain; but for seven weeks after the operation there were intercurrent attacks of pain around the right malleolus, which were controlled by morphin, and after the above-named period ceased entirely.

Four weeks after the operation, when lifting herself upon the bed-pan, she experienced a sudden and vehement pain in the sacral region, radiating down the posterior surfaces of both thighs. After two days this pain ceased, but complete anesthesia around the sacrum, the nates, and rectum, and down the posterior surfaces of both limbs remained. Injections in the rectum would not be felt, and for four weeks the passages were involuntary. There was also a strong tendency to incontinence of urine.

Eight weeks after the operation the wound was healed and the patient was able to get out of bed, but she had to use crutches for four weeks.

Sitting on a hard chair would cause severe pain in the sacral region, which would be relieved only by sitting upon an inflated rubber bed-pan.

The sacral region and nates were in no place tender on pressure, and the skin covering them was so completely anesthetic that a hypodermic injection of morphin would not be felt at all.

After four weeks' exercise on crutches, during which time the right leg was somewhat weak, but painless, she became able to walk with a cane, which she was obliged to use for about two weeks. Slight edema around the malleoli of the right leg would show itself evenings and disappear in the mornings.

Now, March 4, 1881, the patient is able to walk about the whole day, and has no pain whatever in the leg, even after walking two miles. When she gets tired after such a walk she will sometimes feel a pricking sensation along the posterior side of the leg, and occasionally, in bad weather, slight pain in the ankle. When she sits more than two hours in a hard chair she feels pain in the sacral region. The usual sensation with the passages is not quite normal. No fecal matter will pass involuntarily, but sometimes, when coughing, flatus will pass without her knowledge. There is incomplete anesthesia along the external border of the foot and external malleolus, on the nates, and the upper part of the posterior surface of the right thigh. The sensibility of the remainder of the lower extremity is normal, and the muscular strength natural.

In this rheumatic or idiopathic sciatica nerve-stretching may be considered to have had good results, and so much the more since the cases in which it has been resorted to have been obstinate, of from three months' to fifteen years' duration, and the operation has been, so to speak, the *ultimum refugium*, every other mode of treatment having, in most of the cases, been tried in vain before the operation was resorted to. The operation, furthermore, has been so far successful in this disease that in 8 of the cases the one operation was sufficient and no renewal of the stretching was necessary.

The localities in which the nerve has been stretched for sciatica are: (1) The popliteal space, posterior to or above the knee-joint (Bernays, von Nussbaum, and Hildebrandt); or, more commonly, (2) the incisura sciatica, that is, the space between the great trochanter and tuber ischii, where the nerve comes down from beneath the gluteus maximus, is covered only by the skin, and rests upon the quadratus femoris muscle. The latter locality is by far the most convenient for the performance of the operation, partly because the trunk of the nerve is easily found, and partly because a comparatively unskilled operator may perform the operation without risk, as the vessels which accompany the nerve are insignificant in size. The operation in the incisura sciatica has, moreover, the advantage that the nerve-trunk is stretched at a point not far distant from the nerve-center. Langenbuch advises to stretch the nerves as near the center as possible, even if it is not known in what part of the nervous system the action is needed. This renders it more certain that all the nerve-fibers affected will be reached by the operation. In the operation in the popliteal space there is some danger even for the skilled operator, as has been demonstrated in a case reported by von Nussbaum, in which, although the operation had been performed without accident, hemorrhage set in two weeks later, caused by ulceration through the walls of the popliteal vein, produced by the pressure of the drainage-tube.

As to the amount of force which should be employed to stretch the nerve effectively, it is in this, as in all cases of nerve-stretching, impossible to give specific rules for the guidance of the operator. From experiments on dead bodies we know that the average weight required to break the sciatic nerve asunder is 130 pounds (Johnson, Lymington[9]). On another occasion the sciatic nerve was thoroughly stretched by taking it out of the wound and lifting it so that the leg was also raised.

The advice most generally given, and probably the best, is to pull on the nerve-trunk successively, both in the peripheral and central directions, long and vigorously, until a sensation as of something giving way in the trunk of the nerve is experienced. Care must, of course, be taken to cease stretching when this sensation is experienced, so as to avoid a rupture of the nerve-trunk. The danger of rupture is, however, not very great, as no case is as yet on record. The same method may be pursued in the stretching of other nerves.

(*b*) *Symptomatic or Secondary Sciatica.*—This disease is characterized by pain in the territory of the sciatic nerves, dependent upon or complicated with lesions of the spinal cord. In such cases, as might be expected, nerve-stretching has not been as successful as in the former class. Out of 7 cases, only 1 complete recovery is reported (Andrews); in 5 cases greater or less complete relief followed the operation; and in 1 case (Czerny) no effect at all was experienced.

From another standpoint than that of cure of the disease, which in this affection is generally out of the question, it must be admitted that the operation has even here not been performed in vain, for by it the sufferings of the patients have been relieved in great measure. We consider that the good results obtained by this operation have been amply sufficient to compensate for the inconvenience to the patient, due to the operation itself.

CASE 1.—(E. Masing, 1878.[10]) A workingman, thirty-seven years old, had suffered for eight years so severely from neuralgia in both extremities that he was about to commit suicide. For seven years he had been going from one hospital to another without obtaining relief. The muscles of both legs were atrophic; almost complete anesthesia existed in the territory of the sciatic nerves of both sides; the muscles of the legs and feet were paretic; defecation was sometimes spontaneous, and micturition difficult. The sciatic nerves of both sides were stretched under antiseptic precautions. Violent pain was experienced in the first week after the operation. During the second week the pain gradually diminished, and the anesthesia and paresis lessened.

Two months later the left crural nerve was stretched on account of pain on the anterior side of the thigh. The final result was that the anesthesia and pain entirely disappeared, and the paresis was ameliorated until there remained only slight disturbance of motion in the ankle-joints and toes. The urinary trouble, however, continued.

CASE 2.—(E. Masing, 1878.[10]) A boy, ten years of age, after a fall on the sacral region, suffered from contractures of the muscles of the left leg, so that the foot was fixed in the position of pes varus. There was no active mobility whatever; passive movements caused pain; there was general hyperesthesia of the skin of the foot and leg; tenderness on pressure along the sciatic nerve. During sleep and narcosis the spastic contractures relaxed. All other means having been tried in vain, nerve-stretching was resorted to. Immediately after the operation the symptoms increased, and no amelioration set in for seven weeks, after which time the pain and spasms gradually diminished. Seven months afterward the patient's condition was a little better, but he still had pain and was unable to walk.

Case 3.—(Edmund Andrews, Chicago, 1876.[4]) A sailor, who had fallen down a year previous to the operation and fractured two ribs and the right thigh, subsequent to this injury suffered from paresis and anesthesia of both lower extremities. When brought into Mercy Hospital, he complained of spastic contractions and severe pain when his legs were extended, the main symptom being constant tonic spasms of the adducti of both thighs, the contraction being caused, among other things, by touching the glans penis. In narcosis, carried out even to complete anesthesia of the cornea, extension of the lower extremities would cause these spasms to set in. On May 15, 1876, the left sciatic and crural nerves were stretched. After the operation the symptoms on the right side ceased, and when, on May 24, 1876, the same operation had been performed on the right side, the spasms of the left leg ceased. The cure was perfect seven months after the second operation, so far as known—so far perfect, at least, as to enable the patient to perform a sailor's duties on his passage from America to England.

Case 4.—(Czerny, 1879.[11]) Neuralgia in the sciatic nerves of both sides from myelitis, caused by compression, in a case of Pott's disease of the vertebral column. The sciatic nerves were stretched, with no perceptible result.

Case 5.—(Trendelenburg, 1880.[7]) Sciatica consequent upon spinal injury. The sciatic nerve was stretched, with incomplete effect.

Case 6.—(Fenger, 1880.)

Synopsis.—Severe sciatic pain of four months' standing in a case supposed to be central cancer of the bones of the pelvis. Stretching of the sciatic nerve. Cessation of the pain. Progressive cachexia and debility. Death.

Miss Fogarty, unmarried, forty-five years of age, came under the care of Dr. Fenger December 10, 1880. Family history good. She had had no severe illness previously, but had always been rather lean and nervous. Four months previous she was seized with what she believed to be rheumatic pains at the external and posterior side of the left hip, and from there radiating upward along the right half of the sacrum to the lumbar region, and downward along the posterior side of the thigh to the knee-joint. The pain, at first slight, made it difficult for her to walk, and two months later she was obliged to go about on crutches, as the pain became unbearable when the limb touched the ground.

Many kinds of internal and external treatment were tried by different physicians, but the pain steadily increased, and paroxysms set in even when she was sitting or lying down, so that she was not able to sleep at night, and the pain could not be controlled even by large doses of morphin. During these four months her appetite was poor, and she decreased considerably in weight.

On examination, December 10th, the patient was lying on an adjustable folding-chair, the left leg slightly flexed on the hip-joint and resting on pillows. The slightest movement from this position would cause intense pain. Pressure upon the great trochanter would also cause pain, as well as pressure anterior to the joint. No swelling around the hip. The patient was considerably emaciated. Pulse and temperature normal. Lungs, heart, and abdominal organs normal. The urine contained neither albumin nor sugar. The bowels were habitually constipated. There were no signs of paresis or anesthesia in any part of the lower extremities.

As the pain was mainly localized around the hip-joint and the patient would submit neither to an operation nor to an examination in narcosis, extension by means of a weight and pulley was tried to relieve the pain in the hip. For about a week it seemed as if this treatment would relieve the pain, as the patient was able to rest in bed night and day, and suffered much less at night, but in the second week severe paroxysms of pain set in, just as before the extension, and could not be controlled by hypnotics of any kind. She then consented to have an examination made in narcosis, and then, if the hip-joint was found healthy, to have nerve-stretching performed at the same time. Consequently, preparations were made, and on January 6, 1881, Dr. Fenger, assisted by Dr. Dudley, performed the operation.

The patient was anesthetized with ether; the hip-joint was found perfectly movable; the sciatic nerve was cut down upon between the great trochanter, and the tuber ischii taken out without difficulty, stretched vigorously both in the central and peripheral directions, and, after having been compressed and rolled between the finger and the retractor with which it was lifted from the wound, it was replaced, a drainage-tube inserted, the wound united with aseptic silk, and a Lister dressing applied.

The spontaneous pain in the legs disappeared entirely from the time of the operation, so that the patient could rest in bed and sleep all night long, but active and passive movements of the lower extremity would still cause pain on the posterior side of the hip and in the lumbar region. For three days after the operation there was incessant vomiting, which afterward disappeared. Pulse and temperature were always normal. Four days after the operation the drainage-tubes and sutures were removed. Eight days after the operation the Lister dressing was removed, and the wound healed by first intention. In the course of the following four weeks the patient wasted gradually; the appetite, previously poor, disappeared entirely; in the mean time the pulse and temperature continued normal. She would sleep at night and part of the day without hypnotics, and never complained of any pain except when moved to have a passage of the bowels or an injection. In the second week of February she became somnolent, apathetic, no rise in temperature occurring at any time, and died February 12th. An autopsy was not permitted.

CASE 7.—(Fenger, 1880.)

Synopsis.—Severe pains in region of left sciatic nerve in a case of obscure central nervous disease. Nerve-stretching. Healing by first intention. Cessation of pain. Progress of the original disease. Death.

P. N., an Irishman, about sixty years of age, was transferred August 5, 1880, from the medical to the surgical side of Cook County Hospital, and put under Dr. Fenger's care, with a view to the performance of nerve-stretching for supposed sciatica. The patient was greatly emaciated, and absent-minded or idiotic, so that he was not able to give any history of his case. He complained of severe pain on the posterior side of the left hip-joint, radiating from this point down the posterior side of the thigh. This pain set in in frequent paroxysms and did not allow him to sleep at night. The pulse and temperature were normal; the heart, lungs, and abdominal organs were normal; urine normal. His mental condition was one of stupor. He would sometimes pass urine and feces involuntarily in bed, and his appetite was poor.

August 7, 1880: Dr. Fenger stretched the left sciatic nerve in the manner described above. No drainage-tube was inserted. The wound was united by aseptic silk, and a Lister dressing applied. The wound healed by first intention in eight days. The spontaneous paroxysms of pain ceased, but the patient wasted away gradually, and died four weeks later, without any notable change in the symptoms. An autopsy was not permitted.

2. PROSOPALGIA, OR NEURALGIA OF THE FIFTH PAIR

The branches of the fifth pair, operated upon in the recorded cases, have been the supra-orbital and infra-orbital of both sides in 1 case; supra-orbital and infra-orbital of one side, 2 cases; infra-orbital and mental of one side, 1 case; supra-orbital, 4 cases; infra-orbital, 3 cases; and inferior dental, 1 case.

Complete relief was experienced in 9 cases, partial relief in 1 case, and no effect in 2 cases. In the case in which partial relief was experienced, the pain returned a few weeks after the operation. In 2 of the cured cases temporary painful sensations were felt—in 1 case immediately, and in another twice during the first year after the operation. In 3 cases nerve-stretching was combined with excision. In 1 case, after nerve-stretching had been performed with no effect, the nerve was divided and relief followed. The duration of the disease varied from seven months to ten, and in 1 case to fourteen years. Sensibility returned in the territory of the nerve operated upon almost immediately in 2 cases, after two months in 1 case, and after five months in 1 case.

Case 1.—(Vogt, 1876.[4]) Stretching of inferior dental nerve for neuralgia, followed by recovery.

Case 2.—(Crofft, 1877.[13]) Convulsive neuralgia in the territory of the infra-orbital nerve. Five-eighths of an inch of the nerve was excised, and the nerve stretched. During the first year after the operation two light attacks of the neuralgia were experienced. After that time the recovery was complete.

Case 3.—(Charles Higgins, 1879.[14]) The patient was a man, sixty-two years of age, who suffered from neuralgia of the left supra-orbital and infra-orbital nerves subsequent to extirpation of the eye. These nerves were stretched. The operation resulted in perfect recovery, and sensibility soon returned.

Case 4.—(Higgins, 1879.[14]) A man, fifty-three years of age, suffered from neuralgia of the right supra-orbital nerve after extirpation of the eye. The nerve was stretched, with the result of permanent relief from the pain and a speedy return of sensibility.

Case 5.—(Kocher, 1879.[15]) A cigarmaker, thirty-two years of age, had suffered for fourteen years from neuralgia of the right supra-orbital nerve. Nerve-stretching was performed, resulting in immediate recovery and the return of sensibility in two months.

Case 6.—(T. Grainger Stewart, 1879.[16]) A man, seventy years old, suffered from neuralgia of the second branch of the left trigeminal nerve, combined with clonic spasms in the facial muscles of the same side. The left infra-orbital nerve was stretched, with no effect. The same nerve was afterward divided, but no relief from pain was experienced. Finally, the left mental nerve was stretched, and the pain and spasms were permanently relieved.

Case 7.—(Czerny, 1879.[11]) Neuralgia of the supra-orbital and frontal nerves. The nerves were stretched without effect. Two weeks later resection was performed, followed by the use of electricity. This treatment resulted in complete relief.

Case 8.—(Masing, 1879.[17]) A lady, sixty years of age, had suffered from severe supra-orbital neuralgia for about three years. The supra-orbital nerve was stretched, and the patient recovered. For one week after the operation chemosis and diffuse superficial keratitis were noticed, and anesthesia of the forehead and cornea continued for eight months.

Case 9.—(Hahn, 1880.[7]) In a case of supra-orbital and infra-orbital neuralgia nerve-stretching was resorted to, with no effect.

Case 10.—(Purdie, 1880.[8]) The patient had suffered for years from epileptiform neuralgia of the second branch of the fifth pair. A transverse incision was made, and the infra-orbital nerve stretched by means of a blunt hook. This operation was followed by relapse. After five days the nerve was again stretched, and complete relief resulted.

Case 11.—(Von Nussbaum, 1880.) Neuralgia of the supra-orbital and infra-orbital nerves of both sides. Nerve-stretching and excision of the nerves affected were performed. Relief for a few weeks followed the operation, but the patient soon suffered relapse on the left side.

Case 12.—(Walsham, 1881.[17]) A woman had suffered for more than ten years from severe pain in the territory of the infra-orbital nerve. The nerve was stretched at its point of exit from the infra-orbital foramen. The operation was followed by erysipelas, in the course of which two slight attacks of pain were experienced; after this the patient's recovery was complete. Five months after the operation no relapse had occurred.

3. INTERCOSTAL NEURALGIA

CASE 1.—(Von Nussbaum, 1878.[7·18]) A man, twenty years old, suffered from severe neuralgia on both sides, extending from the sternum to the umbilicus. Incisions were made on both sides, along the external border of the rectus abdominis muscle, and the eighth, ninth, and tenth intercostal nerves exposed and stretched. Temporary relief was experienced. A relapse followed, and no further history of the case is reported.

4. IDIOPATHIC NEURALGIAS OF OTHER NERVES

Five cases of nerve-stretching in this class of diseases have been recorded, 2 of which resulted in complete recovery, while in 3 cases the relief obtained was only partial.

CASES 1, 2, 3.—(Langenbuch, 1880.[7]) Brachial neuralgia. The brachial plexus was stretched, with, in each case, only partial relief.

CASE 4.—(Hildebrandt, 1880.[6]) A man, thirty-two years of age, complained first of stiffness of the fingers of the right hand; later, of pain along the inner surface of the forearm, which afterward extended up the arm and right side of the neck. The brachial plexus was stretched, and the patient obtained immediate and permanent relief.

CASE 5.—(Schüssler, 1880.[19]) A lady, fifty-three years of age, had suffered for three years from severe neuralgia in the right half of the occipital region. The trunk of the occipitalis major nerve was laid open, from the place where it passes through the trapezius muscle up to the spina occipitalis externa. The sheath of the nerve was thickened and injected. The nerve was then taken out from the sheath, taken between two fingers, and stretched vigorously in both directions. The wound was closed, and an antiseptic dressing applied. A few slight attacks of pain occurred during the first three days; after that time the recovery was complete. The wound healed by first intention.

5. NEURALGIAS OF THE PERIPHERAL NERVES, CAUSED BY SURGICAL LESIONS INVOLVING THE NERVE-TRUNKS

This class of neuralgias is represented by 11 detailed cases, of which 8 were cured, 2 improved, and 1 a failure. In 1 case it was necessary to stretch the nerve a second time before relief was secured. The nerves stretched were the following: Brachial plexus, 1 case: recovery. The median nerve, 3 cases: 2 recoveries and 1 partial relief. The ulnar nerve, 2 cases: 1 complete and 1 partial recovery. The sciatic nerve, 2 cases: 2 recoveries. The digital nerve, 1 case: recovery. The peroneal nerve, 1 case: recovery. Nerves of the testicle, 1 case: no effect.

Besides the 11 cases reported here, it must be mentioned that Esmarch has performed nerve-stretching several times (the exact number is not given) in cases of neuralgia following amputation, namely, in painful amputation stumps, with invariable success. It seems, therefore, possible that in these obstinate cases nerve-stretching may supplant the former treatment of excision of the scar of the stump, or reamputation.

It has been ascertained that the radial nerve of an adult requires an average weight of 84 pounds to break it asunder.

Case 1.—(Callender, 1875.[8]) Neuralgia in the territory of the median nerve, of one year's duration, subsequent to amputation of the hand on account of injury by a circular saw. The median nerve was stretched, and the patient obtained permanent relief.

Case 2.—(Maag, 1878.[3]) A woman, twenty-three years of age, suffered from pain in the region of the sciatic nerve, of eighteen months' duration, subsequent to an abscess of the thigh. The sciatic nerve was stretched; the wound did not heal by first intention. Recovery.

Case 3.—(Maag, 1878.[4]) Intermittent neuralgia and contracture of the thumb and forefinger of the right hand, subsequent to a punctured wound of the hand. The median nerve was stretched in the sulcus bicipitalis, and the patient recovered.

Case 4.—(Vogt, 1878.[4]) Neuralgia after wound on the inner side of the right forearm, involving the ulnar nerve. The incision was made in the scar, and the ulnar nerve dissected out and stretched. The operation was followed by immediate and permanent relief.

Case 5.—(Czerny, 1879.[11]) Neuralgia subsequent to suppuration around elbow-joint. The ulnar nerve was stretched in the axillary plexus. The patient's condition was ameliorated, but the recovery was not perfect.

Case 6.—(Estlander, 1879.[21]) After a bullet wound through the arm the patient suffered from neuralgia in the territory of the median nerve. The nerve was stretched, and the pain ceased for twenty-four hours. This was followed by a relapse for three weeks. After this time the pain gradually decreased, but the recovery was not perfect.

Case 7.—(Küster, 1880.[7]) Sciatica consequent upon bullet wound. The sciatic nerve was stretched without effect. Nerve-stretching was repeated, followed by recovery.

Case 8.—(Purdie, 1880.[8]) Neuralgic pain in the index-finger subsequent to suppuration under the nail. The digital nerves were stretched; the pain ceased and has not returned.

Case 9.—(Esmarch, 1880.[7]) The peroneal nerve was stretched on account of neuralgia. The operation was followed by recovery.

Case 10.—(Esmarch, 1880.[7]) Neuralgia of the testicle after castration. The external spermatic nerve was stretched, but the operation gave no relief to the pain.

Case 11.—(Credé, 1880.[22]) Ascending neuritis in the territory supplied by the left radial nerve, following traumatic injury. The radial, median, ulnar, and cutaneous axillary nerves were stretched, and the pain, which had been intense for eighteen months, was immediately and permanently relieved.

II. Spastic Anomalies

1. Mimic Spasm. Spasms of the Seventh Pair

The 5 cases of mimic spasm on record were all cured by nerve-stretching. The disease was of from two to eight years' standing. The paralysis following the operation lasted, in the 4 cases in which it was reported, respectively two weeks, eight weeks, two months, and five months. In 1 case the nerve was stretched anterior to the ear, below the zygomatic arch. In the other cases a more central incision was made, that is, below or behind the ear.

Case 1.—(Baum, 1878.[23]) A woman, thirty-five years old, suffered from spasms in the muscles of the left side of the face subsequent to epileptiform attacks. An incision was made anterior to the ear, and the seventh nerve stretched. The operation was followed by paralysis for two weeks, after which time the recovery was perfect.

CASE 2.—(Schüssler, 1879.[24]) A lady, thirty-nine years of age, had suffered for eight years from spasms in the left half of the face and soft palate. The trunk and descending branch of the seventh nerve were vigorously stretched. The relief was instantaneous; a slight paralysis continued for eight weeks. Two months after, there had been no relapse.

CASE 3.—(Allan Sturge and Mr. Godlee, 1881.[12]) A lady had suffered from mimic spasm for over five years. The seventh nerve was stretched below the ear. The operation was followed by paralysis, which continued two months. After that time the recovery was complete.

CASE 4.—(Eulenberg, 1881.[12]) Nerve-stretching was performed in a case of mimic spasm. Paralysis for five months and complete recovery were the results of the operation.

CASE 5.—Dr. Putnam (1881[12]) reports one case of mimic spasm in which nerve-stretching was performed and recovery followed.

2. SPASMS IN THE TERRITORY OF THE ACCESSORY NERVE OF WILLIS—THAT IS, SPASMODIC TORTICOLLIS

Six cases of nerve-stretching in this disease are recorded, only 1 of which was cured by the nerve-stretching alone. In 1 case nerve-stretching gave only partial relief, and in 2 cases it was of no effect. In 1 of these latter cases the relief was subsequently obtained by excision. In 2 cases nerve-stretching combined with excision resulted in cure. In 1 of the last-named cases a return of the spasms occurred for about fifteen minutes, and in the other slight spasms of about one month's duration followed the operation. The disease had persisted from six to eighteen months. The incision was made and the nerve stretched, in each case, at the upper part of the posterior border of the sternocleidomastoid muscle.

From the following cases we conclude that nerve-stretching in this disease is not so efficacious as in mimic spasm, and it seems to be advisable to combine nerve-stretching with excision, as was done in the 2 cases reported by Hansen:

CASE 1.—(Tage Hansen, 1878.[25]) A woman, thirty-one years of age, had suffered for six months from spasmodic torticollis. The nerve was cut down upon at the upper part of the posterior border of the sternocleidomastoid muscle and vigorously stretched, and a piece of the nerve, 12 mm. in length, excised. When the patient awoke from the narcosis, the spasms returned for a quarter of an hour, then ceased, and have not returned.

CASE 2.—(Tage Hansen, 1878.[25]) A woman, thirty years of age, had suffered for one and one-half years from spasmodic torticollis. Nerve-stretching was resorted to, and 15 mm. excised. Slight spasms continued for a month. After this time the recovery was complete.

CASE 3.—(Annandale, 1879.[26]) A woman, twenty-four years of age, suffered from torticollis, the head being drawn to the left so as to look over the shoulder. When an attempt was made to turn the head to its normal position, severe clonic spasms set in. The spinal accessory nerves of the left side were stretched. This operation gave no relief. The nerves were then divided, and immediate relief followed. One year after the operation the mobility was normal and the patient suffered no pain.

Cases 4 and 5.—D. E. Morgan (1879[26]) reports 2 cases of spasmodic torticollis, one of which was cured by nerve-stretching. In the other no effect was produced.

Case 6.—Küster (1880[7]) reports a case of clonic spasms in the muscles supplied by the spinal accessory nerve. The nerve was stretched, but the operation gave only partial relief.

3. Spastic Contractions of the Nerves of the Extremities

To the 3 cases of this disease here recorded might be added the case of Dr. E. Andrews, of Chicago, already mentioned. The case is remarkable as being the only one in which not only the spasms, but also the contracture, ceased, and complete cure was effected. Improvement was produced by nerve-stretching in the other 3 cases: in 2 of them the tonic spasms diminished, and in the third the spastic cramps ceased, but the contracture remained.

Case 1.—(Von Nussbaum, 1872.[4]) Spastic contraction of the left pectoralis major and minor, flexors of the left arm, forearm, and hand, subsequent to bullet wounds of the elbow and neck. Nerve-stretching was performed, the following nerves being included in the operation: the ulnar nerve at the border of the biceps, the nerve-trunks around the axillary artery, and the inferior cervical nerves in the outer part of the supraclavicular region. The patient's condition was greatly ameliorated by the operation.

Case 2.—(Von Nussbaum, 1876.[4]) Tonic spasms in the lower extremity, of eleven years' duration, in a case of paraplegia subsequent to an injury in the sacral region. The sciatic and crural nerves of one side were stretched, and two weeks later the same nerves of the other side. The patient's condition was much improved by the operation—so much so that he was able to walk with the aid of crutches.

Case 3.—(Czerny, 1879.[11]) A student had suffered from birth from hemiplegic contracture with spastic cramps in the right arm, supposed to have been caused by pressure from the forceps during delivery. The axillary plexus was stretched in the axilla, and, later, the supraclavicular plexus. The painful spasms ceased, but the contracture remained.

III. Epilepsy

It is hardly necessary to state that it is only in those cases of epilepsy with an aura from the territory of a peripheral nerve that nerve-stretching can be of use. We have found records of only 3 cases, with recovery in 1, alleviation of the paroxysms in 1, and no effect in the other.

Case 1.—(Von Nussbaum, 1875.[4]) Reflex epilepsy from leg. The tibial and peroneal nerves were stretched. Perfect recovery.

Case 2.—(Czerny, 1879.[12]) Epilepsy with aura from ulnar nerve. No decided effect was noticeable. Bromid of potassium was now given, which gave relief.

Case 3.—(Gillette, 1881.[28]) Congenital epilepsy. The median and cubital nerves were stretched at the upper third of the arm. About 90 paroxysms had occurred during the month prior to the operation. In the month succeeding the nerve-stretching only 18 spasms occurred. The paroxysms diminished not only in frequency, but also in intensity and duration. The greater part of the attacks were merely vertiginous, continuing from two to five minutes. The aura completely disappeared. The wound healed by first intention. The patient experienced a little numbness in the area of the cubital nerve, which disappeared a week after the operation.

IV. PARALYSIS

CASE 1.—(Von Muralt, 1880.[27]) A boy suffered from paralysis of the extensor muscles of the arm subsequent to a fracture of the humerus which had healed in a bad position. The radial nerve was stretched, and complete recovery from the paralysis followed.

V. TETANUS

Of 21 cases of traumatic tetanus treated by nerve-stretching, 9 recoveries and 12 deaths are reported. It would be a great mistake, however, to conclude that the death-rate in traumatic tetanus had been so diminished by nerve-stretching as to reduce it from the usual 80 or 90 to about 40 per cent. The reason for this apparent decrease is that all the successful cases have, of course, been reported, but a number of the unsuccessful ones have not. In the discussion on nerve-stretching at the Congress of German Surgeons in Berlin in 1880, Schede, Hahn, and Sonnenberg stated that they had performed nerve-stretching in tetanus, with no effect.[7] How many unsuccessful cases this statement is intended to include we do not know.

The nerves stretched were always the nerves of the extremities. It is difficult to state the exact value of the operation in those cases which recovered, as presumably in all cases some medicine had, in addition, been given. This question will probably never be solved, because no physician would be justified in risking the life of his patient in this terrible disease by omitting any of the therapeutic remedies at his disposal. We do not, however, consider it just, as some others have done and will do, to deny that nerve-stretching has had any success at all in tetanus, and we think that Morris is not exactly right in his opinion that the cases in which nerve-stretching has proved successful consist only of those subacute and mild cases of traumatic tetanus in which internal treatment alone would have effected a cure.

First, as to the absolute denial that nerve-stretching has been productive of any good results. It will be seen, from the cases recorded, that in severe and even in finally fatal cases there has been a marked, although only temporary, effect: namely, the paroxysms have ceased, and the patient has experienced relief for from twelve hours to three days before a fatal relapse set in.

Second, as to Morris' statement that only the subacute and mild cases have been cured by nerve-stretching. We agree with him to this extent that none of the cases in which recovery has taken place have been cases of *tetanus acutissima*. But when the question of severity is brought up, it is our opinion that the case reported by D'Ollier, which was attended with opisthotonos, difficulty in swallowing, and tetanic contractions of the muscles of the abdomen and lower extremities, can certainly not be counted among the mild forms of the disease.

Further, as to the danger from traumatic tetanus, the statistics of Taylor from Guy's Hospital[29] have shown the following connection between the interval from the receipt of the injury and the first symptoms of tetanus, and the death-rate:

In the cases in which tetanus set in within one week after the receipt of the injury the death-rate was 87.5 per cent.; when the interval was from one to two weeks, the death-rate was 88 per cent.; and with an interval of from two to three weeks the rate of mortality decreased to 57.2 per cent. Consequently, we see that those cases in which the tetanus appeared within two weeks after the receipt of the injury are the more dangerous.

Among the cases of recovery after nerve-stretching we find one interval of seventeen days, one of fourteen, one of eight, one of seven, and one of four. Three of these cases, therefore, so far as the importance of the intervals goes, belonged to the dangerous class of cases.

We willingly admit that the amount of material at our disposal does not enable us to form a decided opinion about the value of the operation as a curative method in tetanus, but we consider it as unquestionably proved that some beneficial effect has been derived from nerve-stretching in this disease.

It seems to us, as a natural and necessary consequence of this, that the operation is imperative in each and every case in which there is any possibility of getting at the nerve-trunks, through which the primary impulse of this terrible disease is conveyed to the central nervous system; and this so much the more as nerve-stretching is an innocent and non-mutilating surgical procedure compared with, for instance, amputation, which has been so often tried in vain that it has been abandoned, not because of the loss of the limb, which would be submitted to gladly, but because of its utter want of efficacy in checking the progress of the disease.

A question as yet entirely open is this: Would not division or section of the nerves be more successful in certain cases than nerve-stretching? Morris expresses this opinion. In one of our own cases, where the axillary plexus above the clavicle had been stretched with no effect, a subsequent division of these nerves caused the very violent and frequent tetanic spasms to cease for twenty-four hours in a severe and finally fatal case of tetanus.

It seems to us that it would be worth while, in these cases, either to combine division of the nerves with the nerve-stretching, or to perform division when nerve-stretching has been performed in vain. Nothing is lost in following either of these two plans; as, first, the ends of the divided nerve will grow together again in a few weeks; and, second, reopening of the wound under antiseptic precautions will not be prejudicial to the healing of the wound by first intention.

CASE 1.—(Paul Vogt, 1876.[30]) A laborer, sixty-three years old, two weeks after receiving a wound in the palm of the right hand, which had healed, was seized with trismus, severe opisthotonos, and severe clonic convulsions. There was no tenderness in the cicatrices nor along the course of the nerves in the arm and forearm, but pain was experienced on pressure on the brachial plexus and neck. The brachial plexus of the right side was stretched above the clavicle. The cicatrices in the hand were also excised. Immediate relief of the symptoms was experienced, and recovery followed. Opium was the only medicine employed.

Cases 2, 3, 4.—Vogt (1876[4]) reports three cases of nerve-stretching in tetanus, two of which were perfectly successful. In the third case the patient died.

Case 5.—Verneuil (1876[32]) reports a case of stretching of the ulnar and median nerves in tetanus with recovery.

Case 6.—(Drake, 1876.[31-32]) A man, twenty-eight years of age, was seized with severe tetanus from a slight injury of the left foot. The sciatic nerve was stretched and calabar bean administered. The convulsions ceased for about twelve hours, then recurred in a mild form for three days, after which time they increased in severity, and the patient died on the twelfth day after the operation.

Case 7.—(Ransohoff, 1879.[32]) A boy, thirteen years of age, wounded the left foot by stepping upon a piece of rusty iron. The wound healed quickly. Eight days after the injury trismus and tetanus set in. The cicatrix was excised, and hydrate of chloral and calabar bean administered, but without effect.

On the fourth day after the tetanus set in an incision was made behind the internal malleolus, and the posterior tibial nerve stretched. The convulsions in the injured limb ceased immediately after the operation. There was a gradual decrease in the severity of the symptoms, and in three weeks the recovery was complete.

Case 8.—(Hutchinson, 1879.[33]) Injury to right leg by a wound from a shot-gun, followed by a high degree of acute tetanus. The right sciatic nerve was stretched with considerable force. After the operation the patient passed a quiet night. The next morning a relapse occurred, and twenty hours afterward the patient died during a convulsion.

Case 9.—(Morris, 1879.[34]) Ten days after a superficial injury of the right foot in a boy seven years of age severe tetanus set in. The sciatic nerve was stretched. A severe convulsion occurred immediately after awaking from the narcosis, and the patient died six hours later.

Case 10.—(H. G. Clark, 1879.[35]) A female, twenty-four years of age, suffered disarticulation of the right hallux by a street-car accident. Seven days later trismus, tetanus, and tenderness along the course of the anterior tibial nerve occurred. Four days later the right sciatic nerve was stretched. Immediately after awaking from the narcosis a convulsion occurred. Calabar bean was administered. The spasms ceased for twenty-four hours. The patient then relapsed. Calabar bean and morphin were given, and ice applied along the vertebral column. The patient recovered in six weeks. In the author's opinion, the course of the disease was not influenced by the operation.

Case 11.—(Dr. Fenger, 1880.)

Synopsis.—Crushing injury to the left forearm. Amputation at lower third of humerus. Tetanus after thirty-six hours. Stretching of axillary plexus above the clavicle. Little or no effect. Forty-eight hours later, reopening of wound and division of nerves of brachial plexus. Paroxysms of pain and opisthotonos entirely stopped for thirty-six hours. Relapse and death after two days.

I. B., a German laborer, fifty-five years of age, was brought to Cook County Hospital August 3, 1880, and placed in the care of Dr. Fenger. A few hours before the left hand had been torn completely off in a machine; the ulna and radius were broken at about the middle; to the hand was attached the skin of the forearm almost up to the elbow-joint; the tendons and muscles of the forearm were irregularly torn. This injury necessitated immediate amputation at the lower third of the humerus.

August 4th: The patient rested well during the night; temperature and pulse normal. Some vomiting followed the administration of ether.

August 5th: Late last night paroxysms of pain in the amputation wound set in, which were followed by trismus, contraction of the posterior muscles of the neck, opisthotonos. Sleep disturbed by the paroxysms. The patient can open his mouth only about ½ inch.

The posterior muscles of the neck are moderately stiff. He does not complain of any pain except at the time of the paroxysms, which occur about every two hours and conclude in twitchings, that is, painful contractions of the muscles of the stump. As the disease was manifestly tetanus, and each paroxysm appeared to have its starting-point in the nerves of the amputated arm, Dr. Fenger resolved to try nerve-stretching of the brachial plexus.

The patient was anesthetized. An incision 6 cm. in length was made in the supraclavicular fossa, ½ inch above, and parallel with, the upper border of the clavicle. The platysma was divided upon the guide, but after this the dissecting forceps alone was used in separating the tissues to reach the brachial plexus. The large nerve-trunks were drawn out of the wound separately by means of the blunt hook, stretched by traction both in the central and in the peripheral ends. These thick nerve-trunks were, furthermore, compressed between the thumb and index-finger. They were then slipped into the wound; a drainage-tube inserted; the wound closed and dressed antiseptically.

August 6th: Yesterday afternoon the paroxysms were fewer in number and less violent. The patient slept some during the night. He says that he feels better than before the operation, but on examination it was found that the lockjaw and stiffness of the muscles of the neck were the same as on the day before. Calabar bean, morphin, and chloral were administered.

August 7th: The patient slept very little during the night on account of spasms in the arm and paroxysms of opisthotonos, which rapidly increased in violence and frequency, occurring every fifteen minutes. The patient looked haggard and anxious.

As the tetanus was evidently progressing toward a fatal termination, Dr. Fenger resolved to divide the nerves in the brachial plexus, thinking that, as the paroxysms had their initial point in the nerves of the stump, division of the nerves might control them.

The patient was again anesthetized. The wound, when reopened, was seen to be agglutinated by perfectly healthy looking, coagulated plasma. The large nerve-trunks of the brachial plexus were easily found, taken out of the wound, divided with scissors, and then replaced, and the wound was closed and dressed antiseptically.

August 8th: The paroxysms of pain in the stump and the opisthotonos have entirely ceased since the operation. The patient slept well during the night, feels much relieved, and talks hopefully. The muscles of the neck are less stiff, but the patient is still unable to open his mouth more than about ½ inch. The internal treatment was continued. The amputation wound was dressed, and no swelling nor suppuration found.

August 9th: The patient had a return of the paroxysms of opisthotonos last night, until they recurred with their former frequency. The convulsions increased during the night, so that they occurred every five minutes. The trismus is unchanged. The patient still takes a good deal of nourishment.

August 10th: Pulse, 130; temperature, 102.75° F. The paroxysms are increasing in violence and frequency. They occur now every two or three minutes.

August 11th: Last evening the patient became delirious. After this the paroxysms stopped. Toward morning the breathing became difficult, the pulse weaker, and he died a little before 9 o'clock this morning.

CASE 12.—(Dr. Fenger, 1880.)

Synopsis.—Crushing injury to left elbow-joint. Tetanus five days later. Amputation at the middle of the humerus, with vigorous stretching of all nerves in the amputation wound. No effect on the tetanus. Twelve hours after the operation, death.

Joe Chastrand, a painter, twenty-nine years of age, entered Cook County Hospital July 6, 1880, and was placed in my care. About 9 o'clock in the morning, while painting at a distance of 55 feet from the ground, one of the hooks holding the flying-stage gave way and precipitated the patient to the roof, 40 feet below. He struck on the head and left side, producing an incised wound, about 2½ inches in length, on the left side of the forehead; dislocation of the left elbow; fracture of the right radius about 1½ inches above the wrist, the fragments having at this point ruptured the skin, making a wound about 1 inch in length; fracture of right half of pelvis. The dislocation was reduced previous to his admission to the hospital.

On admission, four hours after the accident, the patient did not show any evidences of shock, talked well, and suffered but little pain.

The wound communicating with the formerly dislocated elbow-joint was carefully cleansed, a drainage-tube inserted, and antiseptic dressings applied. The arm was placed in a rectangular suspension splint; the other wounds were also dressed antiseptically.

July 7th: Slept some during the night. No fever. The wound at the elbow was dressed.

July 12th: Last night tetanus set in. The arm was amputated at the middle of the humerus, and during the operation the nerves were stretched in the amputation wound.

July 13th: The stretching of the nerves yesterday had no influence at all upon the tetanus, the paroxysms of which increased during the afternoon and night. In the night the patient became delirious, and died this morning.

CASE 13.—(Dr. Fenger, Chicago, 1880.)

Synopsis.—Punctured wound of the right hand. Four days after the injury, trismus and opisthotonos. Fourteen days after the injury, stretching of median, ulnar, and cutaneous internus longus nerves in the sulcus bicipitalis. Immediate relief of the symptoms. Trismus and tetanus entirely disappeared after four days. Paresis in the territory of the median and ulnar nerves for seven months. Neuralgic pains along the trunks of the nerves stretched, and hyperesthesia on the dorsal side of the third and fourth fingers for three weeks. Recovery.

W. H. O'Connor, a carpenter, forty-three years of age, entered the hospital July 10, 1880. On June 26th he ran a rusty ten-penny nail into the palm of the right hand, ½ inch anterior to the pisiform bone. The nail projected from a board about 4 inches, and the wound was made by striking the hand against it. When he pulled the nail out, the blood spurted in a continuous stream, and he lost about half a pint. He had a stream of cold water running upon the wound the whole night to "get the rust out," and afterward put goose-oil on it.

Four days later he experienced pain and swelling in the palm of the hand, and the fingers became stiff. He sought medical aid at the Central Free Dispensary, and was there directed to use poultices of flaxseed meal and bread-and-milk on the wound.

The pain radiated upward from the hand to the mouth and then to the neck. The trismus was so painful that he pounded himself on the sides of the jaw to produce relaxation of the contracted muscles, but without effect. The night before he entered the hospital he had two men pound and squeeze the muscles of the neck and jaw and forcibly open the mouth, but in vain. The pain and swelling of the hand subsided after three or four days, but the trismus and opisthotonos increased to such an extent that he became afraid they would choke him, and for this reason came to the hospital.

On admission he was found to be a well-nourished, robust-looking man. In the posterior part of the thenar of the fifth finger of the right hand was a small cicatrix from the punctured wound which had healed, with no swelling around it, but tender to the touch. The pain radiated upward along the inner aspect of the forearm and arm. The jaws could not be separated more than ⅙ inch, and the posterior muscles of the neck were so stiff that the head could not be moved. He was ordered calabar bean, hydrate of chloral, and bromid of potassium.

July 11th: As the trismus and opisthotonos were the same as on the preceding day, nerve-stretching was resorted to. An incision, 2½ inches in length, was made in the middle third of the arm, over the sulcus bicipitalis. The internal cutaneous, median, and ulnar nerves were taken out of the wound, stretched vigorously in both directions, pressed between the fingers and an elevator of the palpebræ, with which they were taken from the wound, and then reinserted in the wound. No drainage-tube was inserted. The wound was closed with antiseptic silk and a Lister dressing applied.

July 12th: Pulse, 64; temperature, 99.5° F. Last night, eight hours after the operation, he was able to open the mouth a little more, so as to allow the tongue to pass out. The stiffness of the neck continued the same. He slept well during the night, and today, twenty-four hours after the operation, he feels better, and is able to open the mouth sufficiently to admit two fingers. The neck is much less stiff than it was last night, and he can move the head a little. The internal medication was continued.

July 13th: The patient slept well and feels much better. He can now open the mouth freely and move the neck, but the latter is still a little stiff and somewhat painful when moved. The third, fourth, and fifth fingers are painful, and so far paralytic that he can flex them but very little, but is able to extend them. Paresis of the ulnar and median nerves is also present.

July 14th: There is still a little pain in the nape of the neck; no stiffness in the jaws. There is still pain in the third, fourth, and fifth fingers. The patient slept well all night.

July 15th: The patient complains of pain along the course of the nerves which were stretched, considerable enough to render five hypodermic injections of morphin necessary during the day. No stiffness in the jaw or neck. Discontinued the calabar bean, hydrate of chloral, and bromid of potassium.

July 16th: The patient feels numbness on the flexor side of the forearm. He can move the thumb slightly, but can only slightly flex the fingers. There are occasionally stinging pain on the dorsal surface of the hand and shooting pains in the fingers. Pulse, 62; temperature, 98.5° F.

July 18th: He complains of twitchings in the fingers, particularly the middle and ring fingers, which are very sore along the dorsal surface. There is no pain along the inside of the arm, but he complains of pain in the shoulder; is up and about the whole day; sleeps well, and his appetite is good. The interrupted current was ordered to be applied once a day to the arm and hand.

August 7th: The patient can move the fingers better, though flexion is not yet normal. He still occasionally complains of pain in the palm of the hand and the middle and ring fingers.

The patient was discharged to the county poor-house cured.

March 1, 1881: Anesthesia and paresis of the forearm commenced to disappear rapidly.

April 15th: There is no atrophy of the forearm, no anesthesia or pain; there is a little stiffness of the fingers, but active mobility is normal, so that he can flex the fingers until the ends of the fingers touch the palm of the hand. Sensibility of the fingers is normal, but they are a little colder than the fingers of the hand not operated upon.*

Case 14.—(Pepper, London, 1881.[36]) A railway signalman received a crushing injury of the hand, with a lacerated wound. Three fingers were torn off. Antiseptic dressing was applied, and the wound healed rapidly. Two weeks after the injury was received tetanus set in. The median and radial nerves were stretched. The paroxysms were relieved for two days, but on the third day after the operation the spasms recurred violently and the patient sank and died.

Case 15.—(H. D'Ollier, Paris, 1881.[37]) A man, fifty-four years of age, received the following injuries from a tree falling upon him: flesh wound on right forearm; large, lacerated wound on the extensor side of the left forearm, whereby the extensor tendons were denuded; subcutaneous fracture of the left femur. A diffuse, phlegmonous inflammation took place on the third day after the accident, in the right forearm, which was subdued by large multiple incisions. On the tenth day, at a period when the condition of the wounds was very favorable for speedy healing, painful spasms of the flexor muscles of the forearm set in, causing the fingers to be very firmly flexed. These paroxysms increased in number and violence for a week, and then symptoms of tetanus commenced; lockjaw; stiffness of the neck; difficulty in swallowing, and tetanic contractions of the muscles of the abdomen and lower extremities. The patient was anesthetized, the median nerve laid bare in the middle of the arm, and stretched vigorously in both directions. After the operation the pain and muscular spasms ceased and extension of the fingers could be more easily accomplished. Recovery.

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* As a remarkable feature we here mention that, after the anesthesia and paresis of the nerves stretched had persisted for seven months, in spite of all kinds of treatment they disappeared spontaneously in the course of two weeks.

Cases 16, 17, 18, 19, 20, 21.—Nankewell (1879[38]) reports two cases of traumatic tetanus in which no effect followed nerve-stretching. Langton, Verneuil, and Cowper each report an unsuccessful case of nerve-stretching in tetanus, and Ratton places on record a case of tetanus treated by nerve-stretching which was followed by recovery.

VI. Locomotor Ataxia

It was the excruciating and distressing pain, which, at a certain period of this disease, embitters the existence of the patient, that furnished the indication to Langenbuch to try nerve-stretching. The unexpected effect of the operation, namely, that not only the pain was relieved, but also that the symptoms of incoördination disappeared, attracted well-merited attention, as all the remedies hitherto employed in this disease had been devoid of practical value and, in fact, had appeared to exert no influence whatever upon the course of the disease.

The 7 cases which are reported below are of too recent date to enable us to determine whether or not the beneficial effects of the operation were lasting or finally curative. But, nevertheless, the operation has manifestly been of benefit in two very important directions: First, as to the pain. The records show that it has been relieved, or rather has entirely disappeared in the 5 cases in which pain was noted among the symptoms. Second, as to the ataxic symptoms, especially incoördination, loss of muscular power in the limbs affected, and consequent inability to walk or stand. These symptoms entirely disappeared in 2 cases, were markedly diminished in 2 cases, and partially diminished in 1 case in which the muscular strength increased. In 1 case the effect may have been experienced, but is not recorded, and in 1 case only was the operation of no effect as regards these symptoms.

The nerves stretched were both sciatic and crural nerves in 1 case; both sciatic nerves in 3 cases; the left sciatic nerve in 1 case; the axillary nerves in 1 case; and the right median and ulnar nerves in 1 case.

It may be that the 2 cases in which the ataxic symptoms entirely disappeared were cases of only short duration, as in Langenbuch's case, in which the patient died accidentally during the chloroform narcosis for the second operation upon the upper extremity; the autopsy showed no anatomic lesion in the posterior columns of the spinal medulla.

But that even inveterate cases may be effectually acted upon by the operation is shown by Débove's first case, in which, although the disease was of six years' standing and the patient had been confined to his bed for eighteen months previous to the operation, the pain not only disappeared, but the severe ataxic symptoms also diminished so considerably as to allow the patient to stand erect and walk a few steps in two weeks after the operation.

In our own case no effect upon the ataxic symptoms was experienced. It is possible, however, that the complication with large bed-sores, and the subsequent low condition of the patient, masked a beneficial effect which might otherwise have been apparent. On the other hand, the most characteristic symptom, namely, the incoördination, may not be affected at all, as may be seen in Erlenmeyer's case.

As to what and how many nerve-trunks it is advisable to operate upon in a case of locomotor ataxia we shall take into consideration the following facts: The very interesting and unexpected crossed and distant effect of the nerve-stretching, which was first seen as an exception in Andrews' case of painful contractures of the lower extremities, but which has now been fully confirmed, as a rule, in locomotor ataxia, and which has been further confirmed by Brown-Séquard's experiments, leaves it an open question whether it might not be sufficient to operate upon only a limited number of the nerves of the extremities affected. When Esmarch stretched the axillary nerves for pain in the upper extremities the ataxic symptoms of the lower extremities ceased. When Débove stretched the right median and radial nerves the pain disappeared in the opposite arm, and diminished in the arm operated upon. This crossed and distant effect is by no means constant. In has been noted in none of the other cases, and we have as yet no means of determining beforehand in what cases such an effect will take place and in what cases it will not.

It, therefore, seems at present to be the most natural plan to take the indications for the place of operation from the pain, and to commence to stretch the nerve-trunks in the territory in which the most severe pain is suffered. From the effects of this first operation indications for the stretching of other nerve-trunks may be determined. As the inconveniences subsequent to the operation are very few and insignificant, and as the course of the disease is sufficiently chronic so as not to render any rapid surgical interference imperative, it seems to us that no contra-indication exists for this plan of experimental operating by degrees.

Case 1.—(Langenbuch, Berlin, 1879[40, 41]; Westphal, Berlin, 1881.[42]) A merchant, forty years of age, had been several months before attacked with symptoms of tabes dorsalis. When he entered the hospital, the symptoms were so pronounced that there was no doubt that the disease was tabes dorsalis dolorosa. Besides thoroughly developed ataxia, there were peculiarly intense shooting pains in all four extremities. Romberg's symptom was present, and the typical disturbances of sensibility, especially in the lower extremities. In walking, the patient threw off his slippers without being aware of it, and was unable to distinguish what he was walking on. From time to time constriction, as of a belt, was felt. The reflex sensibility was somewhat augmented. The knee symptom was not present, but a high degree of myosis and hyperesthesia of the skin were observed, especially on the anterior surface of the femur. All these disturbances of innervation were also present, though in a less degree, in the upper extremities. The patient was tortured by incessant pain in spite of all sedative treatment.

As the pain was most intense in the region of the left sciatic nerve, Dr. Langenbuch proposed to stretch it. With the patient's consent the operation was performed September 13, 1879. The trunk of the sciatic nerve appeared somewhat reddish, injected, and swollen. Under anesthesia it was thoroughly stretched, and sutures and antiseptic bandages applied. The wound healed in a few days, the patient having experienced entire absence of pain from the moment of the operation. The immediate consequence of the stretching was motor and sensory paralysis, which disappeared in a few days without any return of the pain.

Twelve days after the first operation Dr. Langenbuch was able to proceed to the stretching of the right sciatic and both of the crural nerves in one operation. Under antiseptic treatment the wounds healed in a short time. This operation was followed by the same results as the former; the pain disappeared permanently, and the normal mobility and sensibility were regained in the course of a few days.

When the patient made his first essay at walking, he expressed himself that he now at least knew what he had beneath his feet. The first attempts at walking were feeble and incomplete, but improved rapidly. The unexpected fact was soon discovered that the ataxic symptoms had disappeared at the same time. When the patient had so far recovered that he was able to walk moderately well, he left the hospital.

Later he entered another hospital, when it was found on examination that the ataxic symptoms had entirely disappeared, and that there was no diminution of sensibility in the lower extremities. The patient was able to walk with the aid of a cane, and complained only of the above-named symptoms in the upper extremities.

As the pains in the upper extremity were increasing, and as the result of the operations on the lower extremities had been so unexpectedly favorable, it was resolved to stretch the nerves of the upper extremity, but the patient died unexpectedly during the chloroform narcosis. The autopsy, made by Dr. C. Westphal, demonstrated conclusively that in this case there was no disease in the posterior columns of the spinal cord.

CASE 2.—(Esmarch, Kiel, 1880.[43]) A brief notice was made, in the Ninth Congress of German Surgeons, held in Berlin in 1880, of a case which Quincke had diagnosed as tabes dorsalis, in which violent pains in the upper extremity were experienced. The nerves in the axilla were stretched. The operation was followed by very satisfactory results: not only the pain in the upper extremities, but also the pain in the lower extremities, as well as the other symptoms of ataxia, ceased.

CASE 3.—(Erlenmeyer, 1880.[44]) A man, thirty-nine years of age, suffered from so-called "rheumatic" pains in the right leg in 1871, which continued, increasing slowly until 1878, when manifest symptoms of ataxia were noticed. In December, 1878, paresis of the bladder occurred. In the summer of 1879 the patient became unable to walk or stand. In November, 1879, exquisite ataxia of the lower extremities set in, with a very considerable lack of coördination. The extremities were cold; sensibility was diminished; patellar reflex absent; the patient could not feel the position of his legs at all. He had very little "Druckkraft" (pressure-force). Most of the time there was no pain at all in the legs. Incontinence of urine was present.

Diagnosis: Tabes lumbalis. Prognosis: Unfavorable. All other known remedies having been tried in vain, nerve-stretching was resorted to.

June 22, 1880: The patient was anesthetized with chloroform, an incision made between the great trochanter and the tuber ischii, and the right sciatic nerve exposed. It was lifted from the wound, stretched vigorously, and twisted. The nerve was flattened and of a grayish color.

July 3d: The ataxia, sensibility, and tendon reflex were exactly the same as before the operation, but the "Druckkraft" was considerably augmented, as might be seen by comparing the right leg which had been operated upon with the left leg, which had not. The patient was still unable to stand up.

At this date the left sciatic nerve was stretched in the same manner as in the former operation, strict antisepsis being maintained in each operation. In spite of the antiseptic precautions, however, erysipelas set in in the wound and continued for three weeks.

Examination then showed an augmentation of the "Druckkraft," but no amelioration whatever of the other ataxic symptoms.

CASE 4.—(Débove, Paris, 1880.[45]) A man, fifty-six years of age, was seized, in 1874 with vehement pains in both legs, and six weeks later symptoms of incoördination appeared This was followed by pains in the upper extremities, but no incoördination was here noticeable.

November, 1880, the patient entered the hospital. He complained of attacks of severe pain in the lower extremities, which increased in violence at night. Subcutaneous injections of morphin were ordered, and as much as 3 grains was given in the course of twenty-four hours. Every one or two weeks attacks of gastric, urethral, and vesical pain were experienced. Slight cystitis also existed. Incoördination was present only in the lower extremities, which were highly atrophic. The patient had been obliged to remain in bed for the previous eighteen months. There were bed-sores on his back.

November 18th: An incision was made in the middle of the thigh, the left sciatic nerve retracted, and stretched vigorously in both directions. The nerve was replaced, the wound closed, and an antiseptic dressing applied. From the day after the operation no pain was felt in any of the extremities, and only slight pain in the wound. Formication, from time to time, commenced in the left leg, and from there extended to the right leg. Two days later there was no pain whatever. He could feel his legs in the bed. The incoördination in both extremities had diminished. Two weeks after the operation no return of the pain had been experienced. The sensibility in the lower extremities was normal. He could move the legs so much better that only traces of the incoördination remained. The patient could now stand erect and take a few steps with the support of another person. The wound did not heal by first intention. The gastric trouble disappeared.

CASE 5.—(Débove, Paris, 1880.[46]) On December 16, 1880, a case of locomotor ataxia was operated upon in which the constant severe pains with exacerbations were mainly confined to the upper extremities. The right median and radial nerves were stretched. After the operation the pain diminished in the right arm and disappeared entirely in the left arm, and in the lower extremities the plantar anesthesia diminished considerably on the left side. The incoördination was so much ameliorated that the patient was able to walk without help. He is now able to sleep regularly.

CASE 6.—(Fenger, Chicago, 1880.[47])

Synopsis.—Locomotor ataxia of two years' duration. Incoördination of muscles of lower and upper extremities. Oculomotor paresis with diplopia. Fulgurant paroxysmal pains in lower extremities. Stretching of both sciatic and crural nerves. Healing of wounds by first intention. Cessation of paroxysms of pain. No change in the rest of the ataxic symptoms. Bed-sores. Pyemia. Death.

Charles Grundin, a cabinet-maker, fifty-four years of age, was admitted to Cook County Hospital September 6, 1880. The patient states that his family history is good. His parents died of old age. No hereditary tendencies; no venereal disease. He has used stimulants moderately. Habits and surroundings good. Has had several attacks of intermittent fever of short duration; once suffered from slight dysentery, and once from acute rheumatism. These diseases all occurred twenty years ago. Since that time his health has been uniformly good until two years ago, when he had an attack of incoördination and numbness of the lower extremities, slight strabismus, and ptosis of the left eye. These symptoms were relieved by medicinal treatment in six weeks. Since this time, excepting a slight numbness of the feet and fingers, he has been perfectly well until four weeks before he entered the hospital, when he began to have difficulty in walking, particularly in the dark. He lost considerable strength in the lower extremities, and the pain in the feet and the ends of the fingers increased.

On admission the patient said that, generally speaking, he felt pretty well; his appetite was excellent, bowels regular, and he slept well.

On examination we found a marked loss of coördination in the lower extremities; he was unable to stand erect when his eyes were closed or when he looked upward. There was a marked diminution of cutaneous and muscular sensibility, the patient being unable to perceive the contact of his feet with the floor, the feet seeming to rest on sand. There was paresis of the motor oculi nerve, which was noticeable on account of the diplopia. The patient stated that he had noticed a diminution of his visual powers, especially in the right eye. He complained of occasional difficulty in micturition, it being more frequent and requiring considerable effort. His hands and arms were tremulous, so that he was unable to hold any object steadily. He did not seem to be annoyed by any undue irritation regarding his sexual desire, although he stated that previous to the present illness he had been addicted to excessive indulgence in sexual luxuries. Examination of the vital organs revealed nothing of note.

September 14th: Was given fluidextract of ergot and iodid of potassium. The patient complains of fulgurant pains in the left thigh and leg, which recur several times daily.

October 8th: Feels as though his legs were asleep.

October 14th: He can obtain rest and sleep only by means of morphin.

November 6th: The patient has been unable to walk for the last three weeks, and has been confined to his bed. Suffers pain in both lower extremities. Sleep can be obtained only by the use of morphin. His appetite is poor and he is getting weaker.

December 28th: The patient was anesthetized with ether, and Dr. Fenger proceeded to stretch the nerves of the lower extremity. An incision was made on each side, just below Poupart's ligament, the crural nerves exposed, stretched, replaced in the wounds, drainage-tubes inserted, the wounds closed with aseptic silk, and a Lister dressing applied. The patient was then turned on his face and both sciatic nerves stretched simultaneously, the left by Dr. Fenger and the right by Dr. Verity. Drainage-tubes were inserted, the wounds closed with aseptic silk, and a Lister dressing applied.

December 29th: Temperature, 101° F. Some pain in the right thigh and leg, which was controlled by a hypodermic injection of ¼ grain of morphin.

December 30th: Pulse, 112; temperature, 99° F. The patient has less pain.

January 3, 1881: The wounds were dressed. They looked well and were agglutinated. No suppuration. The sutures and drainage-tubes were removed. He does not complain of any pain.

January 10th: The wounds are entirely healed, and the Lister dressing was removed.

January 20th: The patient's appetite is poor; strength gradually failing. He is not able to stand up. There is no increase of strength in the legs, but he does not complain of pain in the extremities any longer.

February 1st: A bed-sore was found over the sacrum. The patient feels weak, has no appetite, but no pain.

February 10th: Pulse, 110; temperature, 103° F. The bed-sore is considerably enlarged and suppurating. The patient is slightly delirious.

February 15th: The patient died this morning on account of pyemia from the extensive bed-sores.

Case 7.—(Socin, Basle, 1881.[37]) A man, thirty-three years of age, was affected with ataxia, which was characterized by marked troubles of coördination, constricting pain in the body, and violent pain in both lower extremities. The right sciatic nerve was stretched. The wound did not heal by first intention, but, notwithstanding the suppuration, the pain on the right side ceased entirely. The same operation was now performed on the left side. Fourteen days after the second operation was performed the patient died from multiple embolism caused by thrombosis in the right popliteal vein.

VII. Anesthetic Leprosy

Cases 1 and 2.—James R. Wallace (1881[48]) reports, in the Indian Medical Gazette, 2 cases of advanced anesthetic leprosy, which were both greatly benefited by nerve-stretching. In the first case the disease manifested itself in the arm. After the operation the recovery of sensation was perfect, and the patches of discolored anesthetic skin recovered their normal color and sensation. The pain, numbness, etc., disappeared, and at the end of two months the improvement seemed confirmed and complete.

From the résumé given above of the different affections of the nervous system in which nerve-stretching has been tried, with the added abstracts of cases, imperfect as it may be, as only a limited portion of the literature has been at our disposal, it will easily be seen that each class of these diseases or affections of portions of the nervous system will have, in future, to be treated of in a separate chapter of its own, as each of these diseases is different, not only as to the indications for the operation, but also as to the prognosis, the effects of the operation, etc.

It is illogical to speak of or discuss indications, effects, and results of nerve-stretching in general, or to talk enthusiastically for or against the operation as such. Von Nussbaum, two years ago, stated that relapse of the suffering for which nerve-stretching had been performed had not yet been observed, although in some cases four or five years had elapsed since the operation. It will readily be seen that this remark was far too enthusiastic from the present status of our knowledge of the matter. It was only a very short time after this assertion of von Nussbaum was published that Czerný made the much less enthusiastic remark that he would not place any extravagant and exaggerated hopes on the nerve-stretching, but, on the other hand, that he would not deny that the operation was a powerful remedy for the depression of vitality in a nerve-trunk, without its annihilation, and that he would consequently resort to the operation as an *ultimum refugium* in cases in which motor and mixed nerve-trunks had been roused to an abnormal condition of activity from one or another cause. For the sensory nerves he would prefer excision.

Our preceding remarks regarding the necessity of individualization do not permit us to agree with Czerny. This will be seen from several of the facts stated above, namely: A motor nerve, as the seventh, is stretched, with perhaps invariably good results, in mimic spasm. Another principally motor nerve—the twelfth—shows better results by excision than by stretching in spasmodic torticollis. In entirely sensory nerves, as the fifth pair, nerve-stretching has shown somewhat better results than excision, and, finally, the crossed and distant effects from nerve-stretching indicate with sufficient clearness that the benefit of the operation does not depend merely upon the depression of activity in the nerve-trunk stretched, but rather upon its effect upon the nerve-centers, of which we are as yet entirely ignorant.

We should not be surprised if future observers should show that from this effect of nerve-stretching upon the brain and spinal medulla extensive benefit might be derived from the operation, and give further indications for its advisability in diseases in which it had not previously been tried.

A few remarks only remain before we leave this subject.

The duration of the disease of the nerve does not appear to have any direct influence upon the effect of the operation, as it has sometimes proved successful in most inveterate cases. The condition in which the nerve-trunk stretched has been found, namely, injection, swelling, atrophy, anemia, or apparent health, has been of equally slight importance as regards the results.

Whether the wound necessitated by the operation has healed by first intention or after suppuration, or even after complication with erysipelas, it has not affected the final result of the nerve-stretching. The two latter complications, therefore, have done no further harm than the causing of inconvenience to the patient.

As to the question of possible danger attributable to the nerve-stretching, it must be said that, so far as the records go, there has been no danger at all from the stretching of the nerve itself; that is, there has been no neuritis, no tetanus, no permanent paralysis, etc.

As far as the question of danger from the wound is concerned, it may be stated that there is no more and no less danger than from any other incised wound of the same size. It will be almost always in the power of the surgeon to obviate any grave or dangerous complication, by using strictly antiseptic precautions, by being careful of the adjoining organs, by choosing the most appropriate anatomic locality for the operation, etc.

In conclusion, we think that nerve-stretching deserves to have a fair trial, not only in the nervous diseases above referred to, but also experimentally in others, as well of the central as of the peripheral nervous system.

When numerous observations shall be in the future collected, and the cases of homologous affections classified, we shall then have more sharply defined indications for operation than we have had up to the present time, when neuralgic pains or spasms have, with few exceptions, been the main and only indications for nerve-stretching.

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OPENING AND DRAINAGE OF CAVITIES IN THE LUNGS*

WITH J. H. HOLLISTER, M.D.

It is only a little more than a decade since Professor Mosler, of Greifswald, in Germany, conceived the brilliant idea of combating cavities in the interior of the lung by surgical means. It was natural that the consumptive cavity, being the most common in the lungs, and the variety which offered the most desperate resistance to medical treatment, should be the first selected for a trial, for the following reasons:

1. The superficial wall of such cavities was known to be adherent, in most cases, to the wall of the chest; consequently the cavity could be opened without much danger of opening the pleural cavity, and thereby causing a fatal pyopneumothorax.

2. It was believed by a large part of the profession that infection of the still healthy lung tissue was caused by aspiration of the liquefied cheesy matter contained in the consumptive cavities, and this, when brought in contact with still healthy bronchial tubes, would cause endobronchitis and peribronchitis, which were shown by Virchow to be among the most common features in the consumptive destruction of lung tissue.

Mosler opened and drained a superficial consumptive cavity, using a silver drainage-tube. The result, however, did not fulfil the expectations. The patient died in due time from the pulmonary consumption, which had progressed notwithstanding the operation. As a consequence of this, the surgical treatment of consumptive cavities was abandoned, to remain in the history of medical science only as an interesting experiment.

Although Mosler's operation was of no avail in the treatment of pulmonary consumption, it accomplished this much good, that it called the attention of the profession to the surgical treatment of cavities in the lungs, and demonstrated that such cavities might be opened and drained without any of the dangers or inconveniences which, from *à priori* reasoning regarding a hitherto untried surgical procedure, might be expected to arise.

The next step in the surgery of the lungs was to attack less malignantly destructive pathologic processes, which, as we know from observation of like processes in other tissues of the body, may terminate in recovery. These processes include suppuration and gangrene of lung tissue; in other words, abscesses and pulmonary gangrene.

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* Read before the Minnesota State Medical Society, June 20, 1881. Amer. Jour. Med. Sci., 1881, vol. lxxxii, p. 370.

Cavities arising from acute pathologic processes in the lung tissue naturally present themselves as objects for surgical treatment, when the anatomic conditions, that is, the position of the cavity, make such treatment possible, for the following reasons:

There is, in the nature of these two pathologic processes, nothing absolutely fatal, nothing necessarily progressive, as in tuberculosis, when this has developed so far as to form a large cavity. When the contents of a gangrenous or abscess cavity are entirely removed, there remains in the walls of the cavity no disease of the tissues which should necessarily prevent the closure of the cavity. This has been demonstrated by a number of cases of this kind in which spontaneous recovery has taken place by evacuation of the contents of the cavity through the bronchial tubes.

But in spite of the possibility of spontaneous recovery, which in pulmonary gangrene rarely occurs, but is somewhat more common in abscesses, a number of cases remain in which the size and progressive enlargement of the cavity and the gradual failing of the patient's strength enable us to determine, a considerable time before death, that a fatal result is inevitable, and it is in such cases that we are tempted and have the right to claim assistance, by means of surgical interference, for the following reason:

The decomposing contents of such cavities, whether gangrenous fluid or ichorous pus, cause the progressive destruction of the lung tissue *in loco*, namely, the increase in size of the cavities, as well as the general poisoning of the organism by absorption, with rise in temperature and decrease in strength. Besides this, the poisonous contents of the cavities are apt at any time, by aspiration through the bronchial tubes, to give rise to purulent bronchitis, bronchopneumonia, or pleurisy in distant parts of the lungs. Any of these complications may at any time cause a sudden fatal termination before the time at which the gangrene or pulmonary abscess would come to its natural termination by exhaustion.

From the above considerations we are justified in desiring and attempting to evacuate the contents of such cavities, and, in so doing, to expect not only to arrest the progress of the disease and avoid the complications from distant parts of the lungs, but also to cause the closure of the cavities so as to effect a definite cure.

The number of cases of acute cavities in the lungs in which surgical interference has been resorted to is as yet very limited, only six cases having been reported, and these within the last three years. Of these six cases only one, our own case, was successful, in so far that it terminated in a complete recovery.

But even from some of the cases that terminated fatally it was seen that immediate relief and temporary improvement in the patient's condition followed the operation to such an extent that the attention of the medical profession was drawn to the subject, and justifiable encouragement was given to further trials.

The importance of the subject warrants the report in detail of the cases, which we shall give as minutely as we are able, and, having done this, we shall discuss, as far as possible, the most important aspects of the question.

The first two cases, on account of the imperfect reports, but with the diagnosis confirmed by the autopsy, only show that the surgical evacuation of the contents of the cavities gave considerable relief to the patients, and in the second case this relief lasted so long that recovery was fully expected.

CASE I.—*Large abscess of the lower lobe of the right lung. Incision in the mammary region. Washing out of the cavity—immediate relief. Acute pleurisy on the opposite side. Death twenty-nine hours after the operation.**

A man, forty-four years of age, was brought into the hospital suffering from great dyspnea. Examination showed two large fluctuating abscesses in the neighborhood of the right nipple. Pressure over the abscess cavities showed that they communicated with each other, and caused increased dyspnea and cough, which brought up a quantity of pus. The diagnosis was supposed to be an empyema which was about to open through the walls of the chest, and had already broken into the lung.

An incision was made, through which about a quart of pus was evacuated. The cavity was washed out with carbolized water, and the patient experienced immediate relief. On the following day, however, twelve hours after the operation, the fever set in anew, and the physical examination showed that a pleurisy was commencing in the left lung. The patient died twenty-nine hours after the operation. The autopsy showed no empyema, but a very large abscess of the lower lobe of the right lung and a recent pleurisy on the left side.

This case came under treatment at so late a stage of the disease that it has no value as regards diagnosis and the method of operation. It shows, however, that the operation was followed by some relief, and did not in any way hasten the fatal termination, but was performed too late to prevent it.

CASE II.—*Large abscess in lower lobe of left lung. Fetid expectoration. Insufficient drainage through the bronchial tubes. Incision in sixth intercostal space. Drainage and washing out with carbolized water. Marked improvement for twenty-six days. Sudden and unexpected death on the thirty-first day—cause not given.*†

Early in 1879 I was called to see a Bavarian, aged thirty-four, who was much emaciated, but presented the appearance of having been a very powerful man. The patient had a hoarse voice and a rapid pulse, his temperature on further examination being found slightly above the normal. He had had, five years before, a violent attack of pneumonia, from which he had never entirely recovered, but, although for a time somewhat better than during the pneumonia, his general health had become much worse than it had been prior to the attack. Two years subsequent to the pneumonia he had three attacks of hemoptysis, a year after which symptoms of acute pleurisy made their appearance on the left side. At the present time the patient has much cough and a mucopurulent expectoration. On physical examination the right lung is apparently normal. There is a total absence of vesicular respiration on the left side, gurgling, increased on coughing, being present at the same time; there is complete dullness on percussion while the patient remains sitting. On the patient's assuming a recumbent posture, succussion showed a decided metallic tinkling. The recumbent position provoked cough, with increased expectoration having a foul odor. The patient was informed that his case was one of doubtful prognosis, and thereupon left further procedure to the physician. The day following the examination just mentioned I visited the patient in company with Dr. George Rohansen, fully prepared to operate. To determine the correctness of the diagnosis of the supposed cavity the lung was aspirated, giving vent to quite a quantity of ill-odored pus. A bistoury was plunged into the lung at the sixth intercostal space, giving vent to quite a quantity of foul, purulent material, which was ejected with some force when the patient coughed. Two large-sized Nélaton catheters were passed into the cavity through the opening and secured by adhesive plaster at the margins of the wound; carbolized distilled water at a temperature of 100° F. was projected, by means of a Davidson's syringe, through one of the catheters, passing out through the other. The patient experienced the odor of carbolic acid at its first injection. The cavity was washed out daily for a month, the patient being well fed. He was able to be up and about for twenty-six days, and was apparently on a fair road to recovery when he died suddenly on the thirty-first day. At the autopsy an abscess was found involving the entire lower lobe of the left lung. The pleura pneumonalis and costalis were glued together. An enlarged bronchial tube led from the abscess to the trachea.

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* Radek: Centralbl. f. Chir., 1878, vol. v, p. 750.

† R. S. Sutton, Pittsburgh, Pa., 1879; Chicago Medical Review, 1881, vol. iii, p. 112.

This case, although so superficially reported that it does not furnish any tangible points for the differential diagnosis between empyema and pulmonary abscess, has considerably more interest than Radek's case, because it shows—the diagnosis being confirmed by the autopsy—that a large pulmonary abscess was opened, drained, and washed out, with unmistakable relief, and that the effects were so beneficial that the patient seemed, for thirty days, to be in a fair way to recover. The autopsy, valuable as to the confirmation of the diagnosis of pulmonary abscess, failed to demonstrate the cause of the patient's death, and consequently the importance of the case is limited to the immediate consequences of the operation.

The following cases have considerably more interest, partly because the diagnosis was carefully made before the operation, and partly because the main feature in the indications in all these cases was, by the operation, to evacuate fetid or gangrenous matter from pulmonary cavities having insufficient outlets through the bronchial tubes, and where consequently the remaining fetid matter produced symptoms of general poisoning by absorption, as fever, collapse, etc., as well as poisoning of the rest of the lungs, in the shape of diffuse fetid bronchitis. In all these cases except one the operation was followed by decided relief, temporary in two cases, and permanent in our own.

CASE III.—*Multiple fetid abscesses in lower lobe of right lung, subsequent to bronchitis and pleuropneumonia. Hectic diarrhea. Insufficient outlet through the bronchi. Incision in eighth intercostal space, midscapular line. Drainage and washing out with Condy's fluid. Temporary cessation of cough and fetor for three weeks. Insufficient drainage. Return of fetor. Pleuropneumonia on the opposite side. Death fifty days after the operation.**

A man, forty-nine years of age, had bronchitis in December, 1878, and in February,

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* W. Douglas Powell and R. W. Lyall, Lancet, 1880, vol. ii, p. 12.

1879, a pleuropneumonia and fetid expectoration. He improved for a time, but then suffered a relapse. In July, 1879, he entered Middlesex Hospital. On admission there was consolidation of the lower lobe of the right lung, with excavation of its central portion, the cavity signs being located at about the level of the spine of the seventh dorsal vertebra, and in line with the angle of the scapula. There were considerable hectic, diarrhea, and anorexia. The breath and expectoration were extremely fetid, the latter being mucopurulent in character and very abundant, amounting to aboutone pint in twenty-four hours.

The area of excavation having been carefully marked out, the operation was performed September 11th. A medium-sized trocar was first passed in at the eighth intercostal space, midscapular line, and, a free incision having been made through the tissues down to the intercostal muscles, the fine trocar was withdrawn and a full-sized hydrocele trocar inserted to enlarge the opening, through which the drainage-tube was afterward inserted. Carbolized dressings were then applied. A moderate quantity of fetid pus escaped from the wound, and subsequently a free but never abundant discharge from the drainage-tube.

The expectoration and cough almost entirely ceased. The wound was dressed daily under the carbolic spray, and injections of Condy's permanganate of potash solution were used.

October 2d: There was some return of the fetor of breath, the discharge from the tube having always been somewhat fetid. Some trouble was occasioned by the drainage-tube getting out, its reintroduction being rendered more difficult by encroaching granulations, and the tube was felt to strike against some impediment deep in the lung. The channel was kept dilated, however, and the patient improved in strength, and on October 20th was transferred to Brompton Hospital. The fetid sputa returned toward the end of the month, however; the amount expectorated also continued to be very scanty. The patient lost ground rapidly, and was finally attacked by pleuropneumonia on the opposite side, from which he died October 31st, fifty days after the operation.

The autopsy demonstrated several intercommunicating cavities in the lower lobe of the right lung. This lobe was firmly adherent throughout, and a drainage-tube passing through the eighth intercostal space entered the contracted cavity, which was connected with the main cavity by a short, dilated bronchus. It was evident that, in contracting upon the tube, the wall of the cavity partially occluded its extremity. The remainder of the lobe was consolidated by fibroid interstitial pneumonia surrounding bronchiectatic cavities. There was bronchopneumonia with effusion on the left side. The rest of the lung was emphysematous.

Besides the very remarkable relief derived from the operation, this case is mainly interesting because it shows that the insufficient drainage and evacuation were evidently the reason why the latter failed to save the patient's life. And it was here, as in Radek's case, the poisoning of the other lung from the decomposed contents of the cavity which, resulting in a pleuropneumonia, caused the patient's death. In short, we may say that the patient died notwithstanding the operation, on account of the perhaps inevitable insufficiency of the operation, but by no means from any reason for which the operation itself could be held accountable.

A similar condition probably existed in Williams' case, which is mentioned only very briefly—too briefly to allow either deductions or criticisms, but which, for the sake of completeness, we shall mention.

CASE IV.*—Dr. Williams briefly mentions that in one case he passed an aspirator needle into a bronchiectatic cavity without result. On a second tapping, however, he succeeded in evacuating the contents of a limited empyema, which, he thinks, may have been caused by the previous paracentesis.

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* Williams: Lancet, 1880, vol. ii, p. 12.

It is easily seen that in Williams' case it is difficult to determine whether the entire want of success of the operation was due to avoidable inefficiency in the method of operating or to the unavoidable surgical intractability of bronchiectatic cavities in general. Such cavities, on account of their well-known irregularly sacculated and often ramified shape, present very great, if not insurmountable, difficulties for effective surgical interference.

The following case is very interesting, because it presents, notwithstanding the want of an autopsy, a clear case of acute pulmonary gangrene subsequent to a croupous pneumonia. The description of the case, as well from the etiology as from the careful description of the development and physical signs, leaves no doubt as to the correctness of the diagnosis. It is probably the first, if not the only, case of pulmonary gangrene treated by surgical operation, which, as far as temporary relief is concerned, may be accounted a success.

CASE V.—*Gangrenous cavity in middle lobe of right lung subsequent to croupous pneumonia. Insufficient outlet through the bronchi. Adynamic condition of patient. Incision in the region of the angle of the scapula. Drainage with injections of carbolized water. Decided improvement for a week. Cessation of fetor of breath and expectoration. Return of fetid expectoration. Collapse and death twelve days after the operation.**

The patient, a man about sixty years of age, had always been in good health until two months previous to the operation, during which time he had had a little shortness of breath on going up hill. Two weeks previous to the operation he had a sudden attack of pneumonia of the right side, with chills, pain in the right side, pneumonic crepitus, and rusty sputum. The case was not very severe, the temperature never exceeding 102° F., and in about a week he got up. Two days later the cough became worse, he felt weak, had to go to bed, and his breath had an offensive odor.

October 13th he suddenly expectorated half a pint of fetid gray fluid, and sank rapidly into a condition of collapse. On the next day the patient was covered with clammy perspiration, his respiration was rapid and difficult, with loud tracheal râles; pulse, 130, very feeble; could not lie down on account of the cough. The air of the whole room was extremely offensive on account of the gangrenous odor of breath and expectoration. The matter expectorated was principally a thick, tenacious, mucopurulent mass, but frequently alternating with this was a thin, gray, offensive fluid, which seemed to gush into his throat suddenly, in such quantity that he would spit out mouthful after mouthful of about half an ounce each for three or four times in succession. The right side was slightly less resonant than the left, especially at the base and at and under the right nipple. There was less respiratory sound on the right side and less local vibration, but all the sounds were greatly masked by tracheal râles; he had no pain; the tongue was brownish-black and dry, and the patient was very weak. Under invigorating and stimulating treatment he seemed to improve a little for a day or two, but then the expectoration diminished and he became worse. Four days later a quantity of the same fetid fluid as before was expectorated, and he felt a little relieved, but soon afterward the expectoration stopped again and the adynamic condition of the patient increased.

On October 20th distinct cavernous respiration was heard below the spine of the right scapula, and external to and below the right nipple. The diagnosis was now made of a large cavity extending chiefly through the middle lobe of the right lung, with no efficient outlet for the contained fetid matter, and a consequent adynamic condition of the patient from poisoning by the fetid pus. It was now resolved to operate, with a view to procuring an outlet for the fetid matter, for the following reasons:

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*Solomon, Charles Smith: Lancet, 1880, vol. ii, p. 86.

1. That the actual condition of the patient made it certain that he would die, and that very speedily.

2. That there would be some chance for his life if the cavity could be found and an opening made.

3. That it would be justifiable to explore with an aspirator, and if the cavity was found, to enlarge the opening and put in a drainage-tube.

At a point near the angle of the scapula an aspirator needle was inserted for three or four inches. No fluid escaped, but very fetid air was drawn through the tube. On holding a candle near the cannula, the flame was blown to and fro during respiration, so that evidently a cavity had been reached.

Using the cannula as a director, a knife was inserted between the ribs, and by the side of the knife dressing forceps were slipped in and the wound enlarged sufficiently to allow the introduction of a small india-rubber tube. Through the latter, a little carbolic acid solution was injected. This seemed to occasion a fit of coughing, when about half a pint of fetid pus, of the same character as the former offensive expectoration, was forcibly expectorated. The tube was left in the wound, which was covered by a large pad of a dozen folds of coarse muslin, wrung out of a solution of carbolic acid. This dressing was ordered to be changed every three hours.

For the first week after the operation the improvement was very decided. For six days the expectoration was very much diminished. The fetor also became much less, except at the time when the dressing was changed. He enjoyed his food more, and was altogether more comfortable. The respiration became much clearer in the left lung and the unaffected parts of the right lung, the moist sounds being much less frequent, and the tracheal râles only occasional. The discharge from the wound, however, continued extremely offensive, notwithstanding the daily irrigation of the cavity by a siphon. Whenever the dressing was changed, it was found to be soaked with a discharge for an area of five to six inches in diameter. As the water which escaped on washing out the cavity was only slightly stained, the offensiveness was attributed not to any retention of pus, but rather to sloughing within the lung.

Eight days after the operation the discharge had lessened a good deal, but the expectoration now increased and again became offensive. The pulse increased to 112; temperature, 100° F. On the next day he was better in the morning, had less cough and expectoration, and took food well. But the wound was beginning to slough, and a few gangrenous black shreds were discharged through the drainage-tube. In the afternoon he became very ill, with labored breathing, quick pulse, and profuse cold sweats. From this time he gradually became weaker, would take no more food, and died November 2d, apparently from simple asthenia. No autopsy was held.

Isolated as this case stands as an effort to evacuate the contents of an indisputably gangrenous lung cavity, it may be hazardous to venture any justifiable criticism upon the operation in the case in question, from which to deduce any conclusions showing that in such a case the patient's life might have been saved. But it is barely possible that, if an opening had also been made in the anterior wall of the cavity when the cavernous breathing presented itself around the nipple, then more efficient and perhaps sufficient drainage, and an outlet for all the gangrenous matter, fluid as well as solid, might have been effected.

That a double, free, and extensive opening of similar pulmonary cavities, with thoroughly effective drainage, by no means involves any additional danger, but rather, when practicable, is liable to make it possible to save the patient's life, we claim to show by the following case:

CASE VI.—*Large fetid abscess cavity in middle lobe of right lung, caused by suppuration around a large echinococcus cyst of twelve years' standing. Fetor of breath and expectoration. Insufficient outlet through the bronchi. Diffuse purulent bronchitis in the rest of the right ung. Fever, emaciation, and collapse. Exploratory aspiration. Incision in third intercostal space on anterior surface, two inches to right of sternum. Digital exploration of the cavity. Counteropening in fifth intercostal space, anterior axillary line. Removal of the sac of the echinococcus cyst through the anterior opening. Drainage by means of a large rubber tube. Washing out of the cavity with carbolic acid solution. Antiseptic dressing. Definite cessation of fetor of breath and expectoration. Wound closed in six weeks. In the seventh week, bronchopneumonia of right lung, with diffuse purulent bronchitis of this and of the lower lobe of left lung, lasting four weeks. Perfect recovery.*[*]

Francesco Coputo, Italian, a laborer, thirty-four years of age, was admitted to Cook County Hospital and placed under Dr. Hollister's care.

Previous History.—Father died at the age of seventy-seven; mother still living. He has one brother and one sister who are in good health. He had always had good health until twelve years ago, at which time he was a mounted gendarme in Italy, and on duty from three to four hours consecutively. He had at this time a hemorrhage from the lungs of about two ounces, in consequence of which he was obliged to remain in the hospital a week. For the following two years he was well. After this time he had a cough, accompanied by pain around the right nipple. The pain subsided on the application of leeches; the cough also disappeared entirely after a month. In the following years he had every autumn a return of the pain, always at the same point in the chest, between the third and fifth ribs, and around the nipple, accompanied by cough. This would persist for about a month, be relieved by the use of leeches and venesection, and disappear entirely. During the last four years, however, the pain became more severe, as did also the accompanying cough. In the intervals between the attacks he would occasionally feel some pain in the region of the right nipple when lifting a heavy weight on the right shoulder.

He came to New York in 1878, where he stayed a year and a half. He was able to work all this time, except during the usual attacks of the pain and cough in the fall, during which he expectorated mucous matter, which occasionally was slightly streaked with blood. In June, 1880, he came to Chicago and commenced work as a common laborer. In September the pain in the left nipple set in again. It was a steady, unvarying, intense pain, accompanied by only a slight cough. His appetite remained good, and he did not go to bed, but was forced to cease work for two weeks. During October he was at work again. In November he was obliged to stop work on account of a return of the pain and cough. He lost his appetite, became weak, was confined to his bed about half the time, and finally, three weeks before he entered the hospital, he was obliged to remain in bed all the time. During this time he had no appetite, was feverish, would cough up about a pint of mucous matter, sometimes streaked with blood, in twenty-four hours, and was distressed night and day by the cough, which he could subdue only by lying prone in bed. A cataplasm was applied to the chest and some medicine given. Suddenly, about a week before his admission to the hospital, he coughed up a large quantity of whitish matter—as he says, "white, like paper." This was not followed by relief of the pain or cough, which rather increased. He grew weaker and weaker, could not eat, was not able to sleep on account of the cough and pain, and was told by those about him that his breath was offensive, he himself not being able to detect this.

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[*] Christian Fenger, Chicago Medical Review, 1881, vol. iii, p. 57.

On admission the patient was in a profuse perspiration; pulse, 98; temperature, 104° F.; respiration, 36; tongue slightly coated. When he lies on the back and the chest is percussed he coughs incessantly, and a very offensive odor is noticed around the bed. When he lies prone on the right side the cough ceases, and the offensive odor is not so marked.

Examination.—The patient is poorly nourished, tall, and of moderate weight.

Percussion.—When the patient is sitting up in bed, percussion on the right side, over the supraclavicular and infraclavicular regions, is normal, but from the second rib, in the mammary and inframammary regions, the percussion is dull. There is also dull percussion in the axillary and infra-axillary regions, and over the scapular and interscapular regions. In the infrascapular region percussion is normal. When the patient lies on the back, there is an area of tympanitic percussion sound on the anterior side of the body, namely, in the mammary region.

Inspection.—Both sides of the chest participate equally in the respiratory movements. The right side of the chest is neither sunken nor prominent. The intercostal spaces have the same appearance on the right as on the left side.

Palpation.—In the region of the dull percussion the pectoral fremitus is nearly but not quite absent.

Auscultation.—Over the right side of the chest. Sibilant râles in the upper lobe, in the region of the clear percussion, and in the posterior part of the lower lobe. Over the regions of dull percussion the respiratory sounds are obscure. When the patient lies down, auscultation over the tympanitic territories gives cavernous respiratory sounds.

A hypodermic needle was introduced near the right nipple by Dr. W. P. Verity, House Physician, while the patient was sitting up, and some fluid withdrawn, which was thin, grayish, and had the same offensive odor as the breath. On microscopic examination this fluid was found to contain a large number of pus-cells, with fatty detritus and bacteria.

Diagnosis.—Fetid cavity in the middle lobe of the right lung, nearer to the anterior surface, and most superficial at the nipple, having an insufficient outlet through a large bronchial tube in the anterior border of the cavity. Diffuse purulent bronchitis in the rest of the lung. Five grains of quinin, every four hours, and whisky were ordered.

December 22d: The patient feels a little easier. When he is lying on the breast, no offensive odor is perceptible. When he turns on the back, however, the breath becomes offensive, with an odor like rotten eggs, and cough sets in. In the morning the pulse was 84; temperature, 99° F.; respiration, 32. Evening: Pulse, 90; temperature, 102° F.; respiration, 32.

For the next four days the patient remained in the same condition, having exacerbations of the fever at night, and lying prone on the right side in order to avoid the cough and offensive breathing.

December 26th: With the kind permission of Dr. Hollister, under whose care the patient was lying in the hospital, Dr. Fenger saw the patient and resolved to open and wash out the cavity. The reason for the operation was the following:

As the large cavity in the anterior part of the lung had no sufficient outlet through the bronchial tubes by which to evacuate its offensive contents, the poisonous character of which was indicated by the nightly exacerbations of fever and decrease in strength of the patient, it was deemed advisable to attempt to facilitate the evacuation.

Operation.—In the presence of Dr. Hollister, and assisted by the internes of the hospital, Dr. W. P. Verity, House Physician, and Drs. Gudden, McArthur, Bradley, Meacher, Kendall, and Bacon, Dr. Fenger operated in the following manner: The patient was anesthetized with ether. An incision was made, two and one-half inches in length, in the third intercostal space, parallel with the ribs, commencing one and one-half inches to the right of the sternum, and one and one-half inches above the nipple. The tissues were divided until the intercostal muscles were laid bare. A detached hypodermic needle was introduced, and as neither inspiration nor expiration caused this to move, it was withdrawn, and the incision continued into the cavity. When this was opened, about half a pint of grayish-white, offensive matter, intermixed with some air, escaped. The opening was then dilated sufficiently to allow the introduction of a finger into the cavity. By means of the finger soft, elastic lung tissue was felt below the opening; above, the roof of the cavity could not be reached; soft, elastic lung tissue could also be felt on the wall of the cavity, toward the mediastinum, and in the posterior wall of the cavity. In this latter locality the soft, elastic lung tissue decreased in thickness toward the anterior boundary of the axillary region, anterior to which the wall of the cavity was firm to the touch. At this point, namely, between the fifth and sixth ribs, close to the border of the pectoralis major, one and one-half inches to the right of and one and one-half inches above the right nipple, a counteropening was made in the following manner: A urethral sound was passed in at the original opening, and cut down upon at the above-mentioned locality.

A heavy rubber drainage-tube, 10 mm. in diameter, with large lateral openings, was now introduced at the anterior and brought out at the posterior opening. By means of an irrigator a 2.5 per cent. solution of carbolic acid was injected through the drainage-tube into the cavity, which was washed out in this way. As soon as this solution filled up the cavity the patient began to cough. Each paroxysm of coughing forced out from the anterior opening, at the side of the drainage-tube, a jet of fluid, which was thrown from 8 to 10 feet out into the room.

During these attacks of coughing it was noticed that a yellowish-white, coherent mass would appear at and protrude a little from the anterior opening, but would slip back and disappear as soon as the cough ceased. Dr. Fenger attempted to seize this with the forceps and draw it out, but it would break asunder and slip back. With a view to its removal he now dilated the anterior opening a little, introduced a finger and the forceps, and watched for another attack of coughing, which enabled him to get hold of and draw it out as one large, gelatinous, coherent mass.

On microscopic examination of the gelatinous mass removed from the abscess cavity during the operation it was found to be a large echinococcus cyst, the wall presenting the characteristic, finely striped, that is, laminated, layers of amorphous or homogeneous substance, the stripes always running parallel to the surface of the wall of the cyst. The sac, as we here present it to the society, will be seen to be nearly round, and between 5 and 6 inches in diameter. The wall was homogeneous, gelatinous, and transparent, soft and friable, but still somewhat elastic, and presented no secondary cysts, either attached to the wall or free in the cavity.

The cavity was now washed out with the carbolic acid solution until the escaping fluid was perfectly clear. The incision wounds were reduced in size by means of sutures; both ends of the drainage-tube were secured by large asepticized safety-pins, and cut off close to the skin, and the wounds dressed antiseptically, as follows:

A piece of protective was placed over each wound, and a pad, two inches thick, consisting of antiseptic gauze, not in layers, but in a wad, applied so as to cover the entire anterior, lateral, and posterior wall of the right side of the chest. The wad was kept in place by a layer of gauze, and covered with a thick layer of salicylated cotton, over which was placed a large piece of mackintosh. The whole of the dressing was held in place by a piece of cotton cloth, and fixed with roller bandages.

The patient was taken to his bed, and quinin, morphin, and whisky given.

December 27th: Pulse, 88; temperature, 98° F.; the patient's breath has no offensive odor; he can lie on his back without coughing; has slept well; has coughed only a little; no bad odor to the sputum. The wound was dressed; the dressings contained a little bloody pus; the cavity was washed out with 1 per cent. solution of carbolic acid, which made him cough, and forced a jet of fluid from the anterior opening through and beside the tube; the carbolic acid solution passed up into the mouth so that the patient could taste it.

December 28th: Pulse, 80; temperature, 98.5° F. Less pus in the dressings. There is no noticeable offensive odor.

December 29th: Pulse, 90; temperature, 98.5° F. The patient begins to have an appetite, sleeps well, and has very little cough.

The dressings were removed every day. The solution with which the cavity was washed out contained less and less pus.

January 9, 1881: Pulse, 108; temperature, 98.5° F. The water with which the cavity is washed out still has a whitish color.

January 17th: When water is injected into the cavity, he coughs up part of it, and can taste and smell the carbolic acid.

January 21st: About two ounces of pus found in the discharge. If the patient coughs while an injection is being made, the fluid is ejected with great force through both ends of the drainage-tube, from 3 to 6 feet in the air. As the cavity was evidently decreasing considerably in size, the axillary portion of the drainage-tube was removed in this way; the whole tube was taken out, cut in halves, and only one half reinserted through the anterior opening.

January 28th: No discharge in the dressings. The opening in the axillary region appears to have closed. The anterior opening is closing up fast around the drainage-tube. Discontinued the injections into the cavity because it is quite small, and any injection causes great irritation of the bronchi, resulting in paroxysms of coughing. The patient eats well, sleeps well, and his bowels are regular.

February 3d: The anterior wound is still open, but the opening is very small.

February 6th: Both wounds are closed. The patient has no cough; appetite good; sleeps well, and is out of bed.

February 9th: The patient caught cold while walking around the corridor yesterday. Has fever, headache, and cough, which caused him to go to bed. Pulse, 92; temperature, 101.5° F. He has no pain in the chest. He has a cough, which is so distressing that it disturbs his sleep. Numerous moist râles are heard all over the right lung and in the lower lobe of the left lung. Ordered quinin, morphin, and the inhalation of carbolic acid spray.

February 14th: Pulse, 96; temperature, 99.5° F. He coughs a good deal and expectorates about a pint of mucopurulent sputum in the twenty-four hours. His appetite is fairly good. Microscopic examination of the sputum shows pus-cells and epithelial cells in a more or less advanced state of fatty degeneration. No elastic lung fibers found. The sputum has no fetid odor. Ordered a respirator, to the anterior side of which is attached a sponge soaked in 5 per cent. solution of carbolic acid, to be used four or five hours a day.

February 17th: Pulse, 102; temperature, 99° F. Says that the inhalation of the carbolic acid solution makes him vomit.

February 21st: The sputum is still abundant, and moist râles are heard over both lungs.

February 27th: Pulse, 84; temperature, 98.5° F.

Physical Examination, Right Lung.—Over the right clavicular and supraclavicular fossæ there is dull percussion, and numerous fine crepitant râles are heard, both with inspiration and expiration. In the infraclavicular, mammary, and inframammary regions the percussion is normal, crepitant râles spread here and there, accompanying the otherwise normal respiratory sounds. In the supraspinatus and infraspinatus regions the percussion-sound is not exactly dull, but less sonorous than on the left side. In the infrascapular region percussion is normal. A few spread moist râles are heard all over the posterior surface of the lung. The respiratory sounds are otherwise normal.

Left Lung.—The anterior surface is in every respect normal. On the posterior surface the upper half of the lung is normal, but in the infrascapular region numerous fine crepitant râles are heard, both with expiration and with inspiration.

Ordered Griffith's mixture, syrup of morphin, and cod-liver oil, and the continuance of the inhalation of carbolic acid spray from the sponge and by the atomizer. The patient expectorates in twenty-four hours about half a pint of colorless matter, consisting of semitransparent slimy matter intermixed with yellow lumps.

March 4th: Pulse, 72; temperature, 98.5° F. The dullness in the upper lobe of the right lung is subsiding, so that now the inner half of the right clavicular region gives clear percussion. There is still dull percussion, however, over the outer half of the right clavicular and supraclavicular regions. The crepitant râles have diminished considerably over the apex of this lung, and have disappeared in the rest of the lung, except at a point

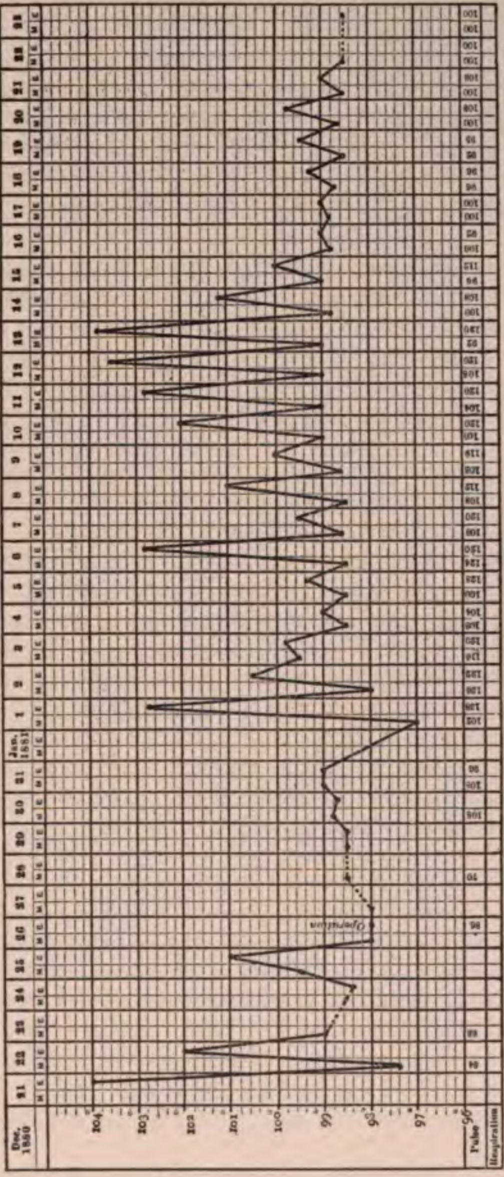

Fig. 30.—Temperature-curve.

corresponding to the lower half of the former cavity, namely, a place in the anterior axillary line, between the fourth and fifth ribs, to an extent of one to two square inches.

March 7th: Very little cough, and this brings up only slimy sputum, not to exceed 1 to 2 drams in the course of twenty-four hours.

March 15th: Percussion is perfectly normal throughout both the right and left lung. Respiratory sounds are normal; movements of both sides of the chest normal. No atrophy or sinking-in over any part of the right lung. The patient has a very slight cough, with a little grayish-black, mucous expectoration, probably from the pharynx or nasal cavity, the color of the sputum being due to its admixture with dust. No râles in any place in the right lung. He sometimes feels slight pain in the above-described limited space in the right infra-axillary region. Pulse and temperature are normal. Appetite good. He has regained his strength, and looks well nourished and healthy.

April 7th: The patient was discharged from the hospital cured.

The first and main question that presents itself in this case is naturally this: Was the disease an ichorous cavity within the lung tissue, or was it a limited pyopneumothorax? As the patient did not die, and as, consequently, we have no final proof, we must base the diagnosis upon the symptoms as given in the description of the case.

The symptoms and the whole course of the disease were so exactly congruent with the description and course of echinococcus of the lung, as given in Ziemssen's Cyclopedia,* that the diagnosis might have been made with a very great degree of probability, even before the evacuation and microscopic examination of the cyst. The pulmonary hemorrhage, pain in the affected lung, recurrent attacks of cough, that is, bronchitis, persistent pain, always at the same place, and increased by bodily exertion—all these symptoms increasing slowly during a long series of years, and, finally, the death of the echinococcus and suppuration in and around the sac, form, taken together, the typical course of a large pulmonary echinococcus. But we know that in very rare cases an echinococcus may develop within the pleural cavity.

The alternating dull and tympanitic percussion, according to the displacement of the contents of the cavity, is, as is well known, exactly the same in extrapulmonary as in superficial intrapulmonary cavities. The position of the cavity at the anterior half of the middle lobe of the lung is unusual for empyemas, but, nevertheless, does not exclude the possibility of their presence. The pathologic character of the cavity as a separate echinococcus sac would favor rather intrapulmonary than extrapulmonary location, not only because the embryo echinococcus, in terminating its wanderings from the intestines to its final resting-place, is obliged, so to speak, to stop and select this somewhere in the solid tissues of one or another organ, rather than to enter a serous cavity like the pleura, but also because we know that the tissue of the lung is, with the exception of the liver, the most common location for echinococci.

This, however, did not exclude the possibility of our having a pleural echinococcus, and, consequently, an extrapulmonary, cavity to deal with, since there are a few indisputable cases on record in which echinococci have been found in serous cavities without any visible primary connection with, or development from, the organs belonging to the cavity.

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* Ziemssen's Cyclopedia, vol. v, p. 462.

Cobbold describes in his book* a case in which an echinococcus sac was found between the liver and diaphragm, having no apparent connection with any of the organs. Cases of similar echinococci in the pleural cavity are also on record, but these are very rare.

The only physical sign which, in the opinion of the authors, enables us to make a differential diagnosis between an extrapleural and an intrapleural cavity, communicating with the bronchi, and filled partly with fluid and partly with air, is the pectoral fremitus. We formerly believed that on the wall of the chest over an extrapulmonary cavity we should find the pectoral fremitus absent, and that on the wall of the chest over an intrapulmonary cavity we should find it increased in intensity. This doctrine is undoubtedly correct as far as consumptive cavities are concerned, but it seems to be open to doubt whether it is the same in cases of abscess or gangrenous cavities, as in Smith's and in our own case the pectoral fremitus over the cavities was lessened, but not absent. In Simpson's description of the symptoms of echinococcus he states that the vocal fremitus is diminished.

The cavernous breathing and tympanitic percussion-sounds are common to both extrapulmonary and intrapulmonary cavities, and even the sudden and violent ejection of the contents of the cavity through the wound of operation may occur in an extrapulmonary cavity when the communication with the lung tissue and bronchial tubes is sufficiently large to admit of the free passage of air from the bronchi during expiration and cough.

As it is sometimes so difficult to make a differential diagnosis by the physical signs alone, this task may be rendered easier by taking into consideration the whole development and course of the disease.

In a case like Smith's, for instance, where, subsequent to an attack of croupous pneumonia, the resolution of the peripheral area of which has taken place and then gangrene set in, in a part of the lung over which the percussion is clear, and in which the breathing has gradually become cavernous, the diagnosis presents, of course, no peculiar difficulties. In other cases, as our own, for example, the differential diagnosis may be difficult, if not impossible, up to the time of the operation, during which it is possible that the examination of the cavity with the finger, that is, the palpation of its walls, may enable us to ascertain the nature of the cavity. In our own case any doubt which might have existed as to the intrapulmonary character of the cavity was dispelled by the examination with the finger, which showed that soft lung tissue formed the lower, inner, and outer wall of the cavity. If the echinococcus had been developed in the anterior part of the pleural cavity, it would have pushed the anterior border of the lung, together with the lung itself, backward, and no lung tissue would have been found on the interior wall of the cavity.

A number of very important questions naturally present themselves whenever a new and somewhat radical treatment is entered upon in a class of diseases which have not been hitherto treated by direct surgical interference. The number of these questions still to be answered is so much the larger, as the cases as yet on record are comparatively few.

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* Parasites, or the Entozoa of Men and Animals, London, 1879, p. 133.

We shall endeavor to enumerate these questions, and point out the direction in which future investigations will have to be made, with a view of bringing them nearer to a solution. We shall, therefore, consider fully the following three points: The indications for the operation, the operation itself, and the after-treatment.

1. *Indications for the Operation.*—What cases of acute pulmonary cavities require or may be benefited by opening and drainage? In examining this question, we must consider not only the possibility of, but also the frequency with which, acute cavities of the lungs, abscesses, of course, rather than gangrenous cavities, have been known to terminate in spontaneous recovery. It will consequently never be advisable to operate at a very early stage of such a cavity, when the general condition of the patient may lead us to expect a spontaneous recovery by evacuation through the bronchi. On the other hand, to wait until the patient has been brought down to the very limits of vital power would be to press the expectant treatment too far. In Radek's case the operation was evidently performed too late.

On reviewing the other cases on record, we think the operation is justifiable in any case where, the presence of a gangrenous or ichorous cavity having been ascertained, it is found that, notwithstanding an outlet through the bronchi for a portion of the contents of the cavity, it steadily fills up again; the partial evacuation does not relieve the patient, who gradually loses strength, and progresses toward a condition of collapse; a steady or intermittent rise in temperature continues; the infection of the healthy portions of the lung from the decomposed contents of the cavity has commenced, or is evidently about to take place; the breath and expectoration continue fetid; absence of appetite; increasing weakness, with or even without fever, etc. These indications will enable any medical man of some clinical experience to determine, in the majority of such cases, when the disease has reached a point from which spontaneous recovery is impossible.

Is the cavity so situated that we can get at it from the outside, and is the pleural cavity covering it obliterated by adhesions, so that we do not run any risk of causing a fetid pyopneumothorax by opening into the cavity and allowing decomposed matter to enter the pleural cavity? In answer to the first part of this question, we may say that any cavity covered by the scapula, or situated within the supraclavicular and infraclavicular regions, may at present be regarded as inaccessible. But from the mammary and axillary regions downward, as well as in the infrascapular region, the anatomic conditions of the wall of the chest do not prevent access to the cavity. Regarding the second part of the question, namely, the obliteration of the pleural cavity covering the field of operation: Such adhesions are to be expected in cases in which the superficial area of the cavity is large, or, more frequently, in which several attacks of the disease have occurred in that portion of the lung where the cavity forms, constituting, in all probability, the primary cause of the gangrene or suppuration, both of which, as is well known, do not set in primarily, but are consecutive or secondary to a number of different primary pathologic conditions of the lung tissue.

In many cases it will be impossible to ascertain whether or not these adhesions exist, and to be sure on this point, we shall recommend the procedure employed in our own case. Make an incision down to the intercostal muscles; pass a needle into the lung, and watch the needle during the phases of respiration. If it does not move synchronously with the respirations, we may be sure that at this place there are adhesions between the layers of the pleura, and may consequently cut in without fear. If the needle does move, we can abandon the operation if we choose, since the small primary incision, as well as the puncture with the needle or plastic pin, if covered by antiseptic dressing, will do the patient no harm.

A question yet to be determined is whether the operation had better be abandoned when the needle moves and the pleural cavity is consequently known to exist. Smith makes a remark in regard to this point, with which we might theoretically feel inclined to agree; that the tapping of a progressive gangrenous cavity through a pleural cavity not yet obliterated would appear only to hasten by a little what would inevitably soon occur of itself, namely, the formation of a fetid pyopneumothorax. There is, however, the compensatory advantage that the incision which caused this empyema is the most essential for its relief.

This is an open question, however, and the ground is very dangerous, as we know that such openings of still healthy pleural cavities have caused rather sudden and possibly inevitably fatal results.

As a last point in the indications for the operation, or rather as a preparatory measure before the operation is resorted to, we should recommend that one or two exploratory aspirations be made with a hypodermic syringe, in the place in which the physical signs may lead us to locate the cavity about to be operated upon. This exploratory aspiration, when fetid matter is brought out from the cavity, not only furnishes us an unmistakable proof of the correctness of the diagnosis of a cavity filled with fetid matter, a mistake in the diagnosis of which would prove a very disagreeable surprise during the progress of the operation, but it may also give us some idea as to the situation of the cavity beneath the surface.

2. *The Operation.*—The operation having been decided upon, the first question is, Where shall the opening through the wall of the chest be made? or, rather, At what point shall we cut in? In cases in which the cavernous symptoms are limited to a single small spot of the thorax, the place of incision shows itself easily enough as the choice of necessity. But cases may occur, like Smith's, for instance, where the cavity comes to the surface at different or distant places. It has been suggested that in such cases the general rules for the opening of abscesses should be followed out, namely, that the lowest point—the point nearest to the bottom of the cavity—should be selected as the place most favorable for the escape of its contents through the drainage-tubes.

As the local and general condition of the patient to be operated upon will not enable him to be out of bed, and as the recumbent position will consequently be necessary, it would seem desirable to select a place for the incision as near the posterior and inferior surface of the cavity as possible. The posterior wall of the thorax has, however, this disadvantage, that the intercostal spaces here are narrower than on the anterior wall of the thorax, and that, consequently, not only the introduction of a sufficiently large tube may be difficult, but the introduction of the finger for exploring the cavity may be entirely impossible, unless resection of a portion of one of the ribs is resorted to. That the latter procedure is not very dangerous in itself we know from operations for empyema, and in case of necessity we shall not hesitate to resort to it. But the excision of a piece of a rib may cause suppurative periostitis and necrosis, and should consequently be avoided when not absolutely necessary.

The most natural way of solving the problem of the place for opening pulmonary cavities seems to us to be the following: Be guided as far as possible by the common law for the opening and evacuation of abscesses in any other part of the body—that is, make two openings; the first, or primary, opening in the most superficial, and in other respects most easily accessible, place to the cavity; then explore the cavity, and by this exploration try to ascertain the deepest point which will allow of a counteropening being made in the most favorable and safe place, for, as nearly as possible, the complete evacuation of the contents of the cavity.

In our own case this plan proved eminently satisfactory, and the existence of two openings instead of one was not only not accompanied by the slightest disadvantage in any way, but, in our opinion, facilitated greatly the evacuation and cleansing of the cavity.

When there is only one opening into a cavity, the evacuation may be perfect; but thorough washing out, even through a double catheter or tube, is, for reasons too obvious to mention, not so efficient as when two openings have been made.

Washing out through a single tube, as has been done in most of the previous cases, causes, from distention of the walls of the cavity and irritation of the bronchial tubes by the fluid injected, so much irritation and so violent a cough that Mosler, Williams, and Lyell were obliged to abandon the injections as too irritating to the patient.

When these authors go a step farther and say that injections into the cavity are not necessary, because the symptoms are relieved and the fetor is stopped by the simple drainage of the cavity, we must say that the facts from the cases recorded do not quite corroborate this assertion, as neither in Smith's nor in Powell and Lyell's case was the fetid condition of the contents of the cavity entirely overcome by the operation alone.

Taking into consideration the fact that in all cases previous to our own only one opening had been made, and only a single drainage-tube employed, it is very probable that to the drainage and cleansing of the cavity by means of the double opening in our own case is to be attributed the instant and permanently perfect result as regards the disappearance of the fetor.

Having thus decided where to cut down upon the cavity, we make an incision, one to two inches in length, in the middle of the intercostal space, parallel to the ribs, down to the intercostal muscles or pleura, ligating any vessels met with. A somewhat free incision is liable to prevent general subcutaneous emphysema from setting in. This does not seem to be very dangerous, however, as in Williams' case, in which the air contained was fetid, no inflammation occurred, and the emphysema disappeared.

The next point is how to make the opening through the pleura, or rather the lung tissue, which possibly forms the peripheral wall of the cavity. We must remember that the lung tissue of the wall of the cavity which we have to cut through may contain arterial or venous pulmonary branches, sufficient in size to cause a considerable and very undesirable hemorrhage, which, in this place, it might be difficult, if not impossible, to control. We, therefore, agree with Lyell and Smith that it is not desirable to make too free use of the knife here, or, as Sutton describes it, to "plunge" a knife into the cavity. A punctured opening should rather be made with a medium-sized trocar, and this opening dilated by blunt instruments, as, for instance, a dressing forceps, sufficient to admit either, as the above author states, a sufficiently large drainage-tube or rather, as we should not hesitate to propose in any case, to admit a finger for the exploration of the cavity.

The exploration of the cavity with the finger serves a double purpose: First, to find a suitable place, at the lowest possible part of the cavity, at which a counteropening may be made safely, that is, without cutting through too much lung tissue or into the pleural cavity; and, second, to ascertain by touch the presence of free sequestrated pieces of dead lung tissue, with a view to their removal. This latter is mainly of importance in gangrenous cavities. In circumscribed gangrene of the lungs a piece of dead lung tissue of the size of a walnut may be found.* The removal of this is, of course, essential to the stoppage of the fetor and of the possible infection of the rest of the lung.

That such a piece of gangrenous lung tissue can be successfully removed and the patient recover has been demonstrated in a case of gangrenous pleurisy reported by Wagner,† in which, by an opening through the empyema, a piece of gangrenous lung tissue, 7 cm. long and 3 cm. broad, was removed, after which the fetor immediately stopped and the patient finally recovered.

The next important point to consider is with what kind of drainage-tube the most efficient drainage of the cavity may be accomplished. Mosler used a silver tube. In all the other cases rubber tubes have been used, but Lyell advocates the silver tube with a shield with which to strap it to the chest, in the same way as the cannula for tracheotomy. In our opinion metal, hard rubber, or any tubes of hard material are dangerous, because there will always be a possibility of hemorrhage into the cavity, caused by ulceration of a vessel in the wall of the cavity from rubbing against the hard tube.

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* Rokitansky: Pathological Anatomy, Sydenham Soc. edition, vol. iv, p. 96.

† Berlin. klin. Wochenschr., 1880, vol. xvii, p. 511.

That ulceration and fatal hemorrhage may take place in this way we know from cases of fatal hemorrhage caused by "usura" of vessels from rubbing against calcareous deposits, the so-called "lung stones," in small pulmonary bronchiectatic cavities which were healing, but in which, for some reason, the irregularly shaped lung stones were not evacuated through the bronchi, but remained in the cavity. Consequently we prefer soft material, as flexible india-rubber, for drainage-tubes for use in lung cavities.

In cases in which it is impossible to make more than one opening into the pulmonary cavity we recommend the use of a double, soft-rubber drainage-tube, which is easily made by cutting the necessary openings in the walls of the tube and bending it in the middle, so that one hole shall be at the bottom of the tube when bent, and several openings on either side of the double tube. This may then be sewed together, and the tube is ready for insertion.

In the cases previously referred to, in which only one opening was made, a single tube was always used, and the drainage was insufficient, because the fetor was not permanently overcome, and the washing out was very irritating, for the reasons stated above.

When two openings can be made into the cavity, we advise that the method employed in our own case be followed out, namely, to introduce a large, soft-rubber drainage-tube through one opening and lead it out at the other. To prevent these drainage-tubes from slipping in or out of the cavity we recommend the use of a disinfected safety-pin passed through the peripheral ends of the tube. If thought necessary, this pin may be easily secured by straps around the chest, and the tube cut off just beyond the pin.

The washing out of the cavity can be effected, without much irritation to the patient, by means of a double drainage-tube when there is only one opening, or of a single perforated tube when there are two openings, provided the fluid is not injected too vigorously.

The thorough washing out of the cavity is important as long as any fetor remains. With what solution this should be accomplished is an open question. Lyell used Condy's fluid; Smith, a solution of carbolic acid of unknown strength, and in our own case we used for the first irrigation a 2.5 per cent. solution of carbolic acid; later, a weaker (about 1 per cent.) solution, and finally, when no fetor was perceptible, either in the discharge or breath, a solution of thymol of the usual strength was employed.

There is no doubt that the carbolic acid is the most efficient as a disinfectant, but there is always some danger of carbolic-acid poisoning when we have to wash out a cavity under such conditions that we cannot be sure of removing the whole amount of the fluid injected. For this reason we recommend the following plan for the washing out of fetid lung cavities: Commence to wash out with a 2.5 per cent. solution of carbolic acid; follow this either with a weaker solution or with thymol solution of the usual strength. Let this procedure be repeated at each successive washing out of the cavity until the fetor entirely disappears, and then use the innocent thymol solution as long as there is any considerable discharge from the cavity. When the discharge stops, discontinue the injections.

The dressing of the lung operated upon should consist of voluminous antiseptic dressings, namely, a wad, two to four inches thick, of Lister's gauze, surrounded by a layer of salicylated cotton, one to two inches in thickness; the wad of gauze and cotton should cover the entire side of the chest; over this should be placed a large piece of mackintosh, and outside of this a set of roller bandages should be applied, to keep the dressings in place.

3. *After-treatment.*—The dressings should be changed as often as may be necessary, according to the amount of the discharge. Smith had the dressings changed every three hours. In Lyell's and also in our own case the dressings were changed every twenty-four hours. We do not recommend the removal and change of the dressings oftener than once in twenty-four hours, except when the discharge is so copious as to soak entirely through the bandage. Frequent changing of the dressings disturbs the patient, who needs rest.

The medical treatment is simply symptomatic: Quinin, when there is a rise in temperature; morphin or opiates for the cough; wine and other alcoholic stimulants to keep up the strength, and nourishing food of any kind, as much as can be taken, are all indicated.

The drainage-tube should be removed when the cavity has filled up and retracted so as not to retain any fluid in the edges, and when, consequently, the discharge has stopped.

It is important not to remove the drainage-tubes too early, because the external openings are liable to close up before the cavity is closed, as we know from Lyell's case, in which the reintroduction of a drainage-tube that had slipped out was made difficult by encroaching granulations in the canal leading to the cavity, and, as we know from general experience, from old empyemic fistulas. In our own case, we think that the drainage-tube was removed too early, and that this mistake placed the patient's life in jeopardy. It will be seen, from the history of our own case, that after the removal of the drainage-tube and the closing of the external wound, when we thought everything safe and all right and the patient was allowed to be up and around, suddenly diffuse bronchitis and bronchopneumonia set in in the whole upper lobe of the affected lung, and bronchitis in the lower lobe of the other lung. When this serious complication set in we were convinced that it originated from aspirated matter—from the not yet fully closed pulmonary cavity, notwithstanding the absence of any physical signs indicating such a condition of the cavity, and we watched the case from day to day, seriously contemplating the reopening of the anterior wound and reëntrance to the cavity, if the general condition of the patient should not improve within a few days. The operation, however, did not take place, as the bronchitis and pneumonia subsided under general treatment, combined with inhalations of carbolic acid through a steam atomizer and sponge. Thereafter recovery was uninterrupted and perfect.

The secondary bronchitis and bronchopneumonia are undoubtedly the main dangers we have to encounter during the course and after-treatment of cavities in the lungs, whether or not surgical treatment has been resorted to. It was found to be the cause of death in Lyell's case; it jeopardized the recovery in our own case. In Smith's case no postmortem examination was made, and in Sutton's and Williams' cases the records are not sufficiently explicit to throw any light upon this subject.

From the slight amount of material existing it seems evident that this bronchitis and bronchopneumonia are essential complications of cavities in the lungs, distinguishing such cavities from fetid intrapleural cavities and empyemas, and give an interesting hint as to the importance of effective surgical treatment.

In conclusion we shall say that the whole subject of the surgical treatment of intrapulmonary cavities is so new, and the important questions as to all the details so many, that our paper of today cannot be considered as attempting to solve any of these questions definitely.

As to the practical value of the operation, the objection might be and has lately been made that the number of cases in which this treatment may be indicated is very small. From a scientific and even from a humanitarian point of view this objection, it is needless to state, is entirely valueless.

That this new field of surgery deserves to be entered upon and have a fair trial is beyond question, not only from a practical point of view, as a temporary relief has been obtained in most of the cases on record, and a permanent cure in our own case, but also from a scientific point of view, as the procedure we have advocated is entirely rational, that is, in conformity with the physiologic and pathologic facts and laws governing the diseases in question.

We finally hope and trust that our case and our remarks may encourage other members of our profession to take the matter in hand and contribute to the solution of this problem, which, even if only occasionally, certainly may save a human life otherwise irrevocably lost.

OPENING AND DRAINAGE OF THE LARGE JOINTS IN SUPPURATIVE SYNOVITIS*

WITH E. W. LEE, M.D.

FROM the earliest period of medical science we have been accustomed to regard the suppurative inflammation of the large joints as a disease, not only serious as to the fate of the joint and limb, but even as dangerous to the patient's life. Cases were on record in which the spontaneous or artificial opening of suppurative articular cavities terminated successfully as far as the patient's life was concerned, but with almost always greater or less destruction of the joint and the usefulness of the limb. These cases, however, were not sufficient in number to justify the earlier timely incision into the cavity of the suppurating joint as a regular procedure, and it was a matter of more or less doubt in most cases whether an amputation would not be the surest way to save the life of the patient. In fact, a large number of amputations have been performed on this indication.

It was a step forward in conservative surgery when Dieulafoy's capillary aspirator was brought into use for evacuating the pathologic fluid contents of cavities of the joints. The expectations of benefit to be derived from this new operative procedure, however, were not realized in suppurative synovitis, so much as in simple synovitis or in hemarthros. We do not say that no benefit at all was derived in some cases by the aspiration of pus from articular cavities, but in a large number, we might almost say the majority, of cases the aspiration of pus proved insufficient, as, after an only temporary relief, the pus gathered again, distended the capsule, and caused a renewal of the pain and the other symptoms of inflammation.

It is to Lister and to his antiseptic method of operating and dressing that we are indebted for the latest and most efficient step in the treatment of this serious surgical lesion. It is Lister who has secured for us the permission, without fear of any evil consequences, to make a timely and free incision into a suppurating joint, which would make us sure of saving the life of the patient and would also give us a reasonable hope of saving the usefulness of the joint, to an extent which depends in each special case, of course, partly upon the condition of the tissues of the joint involved in the inflammation and partly on the pathologic character of the disease which caused the inflammation.

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* Select topics of Modern Surgery, illustrated by cases from the hospital service and private practice of Drs. Christian Fenger and E. W. Lee, Chicago. Gaillard's Med. Jour., 1882, vol. xxxiii, p. 201.

In reporting the following cases, and thereby calling the attention of the profession to this subject, we do not claim to give anything new or not already widely known, but we believe that there still exists some fear of employing this surgical procedure, and we know that it is not yet as extensively resorted to as it deserves to be.

The chief benefit derived from the early opening of suppurating joints is not only the saving of the life of the patient, but still more the saving of the limb. In future it will hardly be necessary to amputate for suppurative synovitis, as far as we can see, because the timely incision and drainage will prevent the formation of the extensive periarticular abscesses, and will enable us in all cases where no extensive acute osteomyelitis is present to gain time enough, after having attempted to save the joint, to make the excision of the joint, if the superficial destruction of the articular surfaces has already become so extensive as to make the excision a necessity, and without endangering the patient's life.

Having given due credit to Lister for his antiseptic method as a *conditio sine qua non* for entering upon this new method of treating suppurating joints, we will now state that the report of the first series of cases thus treated was published by Schede,* who reported 5 cases of suppurating knee-joint treated by incision, drainage, and washing out, 3 of which recovered with a movable joint; in 1 case the result was undecided, and in 1 the patient died from some other disease.

Since this time, the latter part of the last decad, a number of similar cases have been reported by the followers of the Lister method in all countries, but it must be said that the cases reported are still somewhat sporadic, because the majority of private practitioners have not yet dared to adopt this apparently somewhat radical interference with suppurative inflammation of the larger joints.

It is natural that the more superficial of the larger joints, that is, such as present portions of the synovial cavity covered only by aponeurosis and skin, should be the first in which this treatment was tried, in preference to the joints covered with a thicker layer of muscles or tendons; in other words, that the knee and ankle, elbow and wrist, should be subjected to this treatment before the shoulder- and hip-joint. In fact, we know only of very few cases in which the two last-named joints have been subjected to this treatment, and we shall here only touch upon the subject as far as our own experience goes, and keep within the limits of the knee- and ankle-joint.

1. KNEE-JOINT

The anatomic conditions of the knee-joint make it not only the most accessible of all the joints, but permit us to diagnosticate with great accuracy even a slight augmentation of the quantity of fluid contained in the synovial sac. As in the extended position of the knee-joint all the fluid contained in the capsule is accessible from its anterior surface, the posterior wall of the capsule being stretched to its fullest extent, the evacuation and washing out are possible in the most effective way, as there is hardly any space or sinuosities on the posterior side of the joint where the pus or injected fluid can gather or remain after the operation. The above-named facts will account for the almost invariably good results of this abortive treatment of suppurative inflammation in this locality. As examples, we shall here give the following 2 cases:

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* "Ueber Gelenkdrainage," Arch. f. klin. Chir., 1874, vol. xvii, p. 519.

CASE I (Fenger, 1879).—*Synopsis.—Suppurative synovitis of left knee subsequent to traumatic injury. Repeated aspirations of pus from the cavity of the joint with no effect. High fever, rapid loss of strength. Double incision into the cavity of the joint on both sides of the patella. Drainage with india-rubber tube and washing out with 2.5 per cent. solution carbolic acid. Rapid decrease of fever and local inflammatory symptoms. Drainage-tubes removed respectively after nine and twenty-one days. Wounds healed in four weeks; thrombosis of posterior saphenous and crural vein; recovery with useful limb and somewhat limited mobility of joint after six months.*

Annie Smith, a servant, twenty-one years of age, entered Cook County Hospital May 30, 1877. On admission she states that six weeks ago she fell down a flight of stairs, and about a week afterward began to have pain in the left knee. She thought it was rheumatism, tried various remedies, and kept on working until two weeks previous to admission, when the knee became more painful and began to swell, and a week later she became unable to walk and was confined to her bed.

On examination the left knee was found to be considerably swollen and tender to the touch. There is a moderate amount of fluid in the capsule and considerable pain on any movement of the joint. The patient is well nourished; sleeps fairly; no appetite; bowels constipated, and feels sick at the stomach.

June 4th: Vomits all she eats and has considerable pain.

June 5th: Pulse, 108; temperature, 103° F.

June 8th: Dr. Baxter made an exploratory aspiration with a hypodermic syringe, which showed that the knee-joint contained pus. Applied the aspirator and drew off a large quantity of pus from the cavity of the joint.

June 16th: Elastic bandage applied.

June 26th: Pain increasing and effusion reappearing.

June 29th: The joint was again aspirated and another quantity of pus evacuated.

July 1st: The patient came under Dr. Fenger's care. Her condition was now as follows: Pulse, 160; temperature, 105.2° F., notwithstanding large doses of quinin, which had been administered for the two preceding days. She vomits constantly, is weak, and complains of constant intense pain, which does not allow her to sleep. The left knee is considerably enlarged, very painful to the touch, and shows considerable and well-marked effusion in the joint.

The region of the joint of the knee was now washed with a 5 per cent. solution of carbolic acid, and, under the spray, Dr. Fenger opened the joint, making an incision on each side of the patella, whereby a large quantity of pus was evacuated. A drainage-tube was then inserted and the ends stitched to the wounds. The cavity of the joint was now washed out with a 2.5 per cent. solution of carbolic acid, and a Lister dressing applied.

During the operation the spray gave out, from blowing out of the tube, and irrigation over the wound with 5 per cent. solution of carbolic acid was substituted. The limb was placed in a blanket splint in a somewhat elevated position. At 8 o'clock in the evening the pulse was 160; temperature, 104° F.; at 10 o'clock, temperature, 103.2° F.

July 2d: Pulse, 112; temperature, 101° F. No pain in the knee-joint; persistent vomiting. In the evening, pulse, 116; temperature, 102.5° F. Ordered for vomiting subnitrate of bismuth in 5-grain powders and small pieces of ice.

July 3d: Pulse, 106; temperature, 100.7° F. Less vomiting; feels easier; no pain in the knee. Ordered port wine, one tablespoonful every two hours.

July 4th: Dressed the knee; small quantity of pus escaped from the drainage-tubes. During the washing out there was no collection of pus in the cavity. The joint was only slightly tender on pressure, and the skin, which was red and tense before the operation, was now normal. No swelling about the joint. Menses appeared.

July 5th: Pulse, 104; temperature, 100.5° F. Patient comfortable. Evening, pulse, 110; temperature, 103° F.

July 6th: Pulse, 100; temperature, 100.5° F. Wounds dressed. One and one-half drams of pus escaped. Only slight soreness over the joint. Temperature in evening, 103° F.

July 7th: Pulse, 100; temperature, 100° F. Some vomiting, no pain. Evening, pulse, 120; temperature, 100.4° F. Patient comfortable.

July 8th: Pulse, 112; temperature, 100.2° F. Has slept well all night; has slight diarrhea. Ordered camphor and opium pills.

July 9th: Pulse, 100; temperature, 98.5° F. Wounds dressed. Some pus in the dressings. Very little pus brought out by syringing the drainage-tubes. The region of the knee-joint not tender except around the inner incision. The drainage-tube was removed and a shorter one inserted in the inner opening. Evening, pulse, 102; temperature, 100.3° F.

July 13th: Pulse, 99; temperature, 98° F. Since morning a little pain along the posterior side of the thigh. No pain in the knee. Evening, pulse, 116; temperature, 102° F.

July 14th: Pulse, 98; temperature, 99.5° F.

July 17th: Edematous swelling of the foot and leg.

July 19th: Pain in the leg.

July 21st: Dressed the knee. No discharge of pus: no pain; drainage-tube removed.

July 30th: Wounds healed.

August 14th: Leg and thigh swollen and tender; foot edematous. Pain in posterior surface of the calf of the leg and along the inner border of the gastrocnemius.

September 3d: Obstinate vomiting.

September 12th: Quite comfortable. Ordered iodid of iron pills.

October 3d: Put on a plaster cast extending from the toes to the upper third of the thigh.

October 6th: Walked about a little on crutches with the cast.

November 3d: Pain in the right knee-joint, which disappeared in a few days.

November 29th: Left hospital.

June 5, 1880: The patient came to Dr. Fenger's office. She was now able to walk without a cane and without limping. She wore a flannel roller around the knee, which was found to be movable. There was no pain in the knee-joint, but some stiffness still remained, the patient being unable to flex it more than to about 80 degrees.

This case is interesting and instructive in several respects as regards the value of the operation. It first shows that the aspiration alone, that is, the evacuation of the pus in the synovial cavity, was utterly inefficient as to the stoppage of the progress of the disease. The aspiration relieved for a few days the pain caused by tension from the accumulated fluid, but the pus quickly gathered again, the suppuration went on unchecked, the patient lost ground, and the fever reached the dangerous point of 105.2° F.

At this stage of the disease the double free incision and washing out produced a most remarkable and immediate effect, as will be seen from the record of the temperature. This went down within twelve hours from 105° to 101° F., never to rise again except occasionally in the evening for a week, after which time there was no rise in temperature attributable to the knee-joint, the subsequent rises in temperature being caused by a thrombosis in the saphenous and crural veins at the close of the second week after the operation, and later, in the fourth and fifth week, by an obstinate diarrhea which set in at a period when the wounds into the knee-joint were closed and no traces of acute inflammation were to be found in the joint.

The pain in the joint disappeared almost immediately, and the suppuration ceased in less than three weeks, when the drainage-tubes were consequently removed. There is little doubt that this patient, at the time of the operation, had reached a point at which, in former times, amputation would have been justifiable, with a view only to the saving of the patient's life, since a temperature of 105° F., under such circumstances as those given above, indicates imminent danger to the life of the patient.

The result as to the mobility of the joint was not perfect, as six months after the operation the patient was not able to flex the knee to a right angle. But this moderate stiffness, attributable, of course, to the inflammatory retraction of the synovial membrane, does not lessen the value of the operation, under the circumstances, as we know that in former times we used to regard even a complete ankylosis as a more favorable termination than a suppurative synovitis of the knee-joint.

That a perfect result as to mobility may be obtained is shown by the following case:

CASE II (Fenger, 1880).—*Synopsis.—Acute polyarticular rheumatism, followed by suppuration of the knee-joint. Repeated aspiration—no effect. Double incision, drainage, and washing out of the joint. Discharge stopped and drainage-tubes removed respectively after two and five days. Wound healed in fourteen days. Splint removed in eighteen days. Recovery with movable joint in four and one-half months.*

L. N. Munthe, forty-eight years of age, a clerk, was transferred July 5, 1880, from the medical to the surgical side of Cook County Hospital, where he had been treated for acute polyarticular rheumatism, as a result of which suppurative inflammation of the right knee-joint remained. The joint had been aspirated twice and a considerable amount of seropurulent fluid drawn off, but the cavity of the joint always refilled. The patient was, therefore, transferred to the surgical side of the hospital and placed under the care of Dr. Fenger.

On examination the joint was found to be considerably swollen and painful to the touch, with fluctuation of the patella.

July 14th: Dr. Fenger opened the right knee-joint on both sides of the patella, and a considerable amount of serofibrinopurulent fluid was evacuated. A drainage-tube was now inserted and stitched to both openings; the joint washed out with 2.5 per cent. solution of carbolic acid, and antiseptic dressings applied. The limb was placed in the zinc splint always used by Dr. Fenger in resections of the knee-joint, and suspended. After the operation the patient's pulse was 94; temperature, 99.2° F.

July 15th: Pulse, 90; temperature, 99.7° F.

July 16th, A. M.: Pulse, 90; temperature, 99.2° F. P. M.: Temperature, 101.5° F.

The knee was washed out and dressed; very slight discharge; outer half of drainage-tube removed.

July 17th: Pulse, 90; temperature, 99° F. No pain when the limb is kept immobile.

July 18th: Pulse, 90; temperature, 100° F.

July 19th: Pulse, 85; temperature, 99.1° F. No discharge whatever from the joint. Removed the last and inner half of the drainage-tube. From this time on no increase in temperature took place.

July 28th: The openings for the drainage-tube entirely healed; no fluid in the cavity of the joint. Removed the splint and applied a roller bandage around the joint.

August 7th: No effusion in the joint, which can be flexed at a right angle. Applied a plaster-of-Paris cast and allowed the patient to be up on crutches.

A month later the patient was discharged from the hospital. At this time he was able to walk with the aid of a cane and could bend the knee to a right angle. He had a feeling of weakness when walking, but felt no pain.

November 22d: No swelling of the joint. The patient can flex the limb to more than a right angle. Can walk about the whole day without pain or weariness. Excepting about ½ inch of atrophy of the muscles of the femur, the limb operated upon is just as sound as the other, and the patient commenced work again.

The suppuration in this case was of a less acute or rather less intense character than in the preceding, as it was not followed by any considerable rise in temperature. The main indication for the operation was not so much to save the patient's life (this was in no immediate danger, as his temperature was uniformly low), as to preserve the usefulness of the joint by preventing destruction of the cartilage covering the articular surfaces, and destruction and thickening of the capsule and ligaments. We know that these pathologic conditions are liable, if not almost certain, to set in when the articular cavity is allowed to contain pus for a certain time, even when the inflammation is not of the most acute character. In this respect the operation proved a perfect success, as four months afterward the patient had the use of the limb with a perfectly movable joint.

Before leaving the subject of the knee-joint we shall say a few words about the operation and after-treatment. As to the operation: After a thorough disinfection of the entire region of the joint by means of carbolized soap, nail-brush, and 5 per cent. solution of carbolic acid, we should recommend that an incision be made on each side of the patella, about ½ inch from its external and internal border, into the synovial cavity in the following manner: after the first incision has been made, a probe is introduced and brought over to the other side of the patella, and a counterincision made on the point of the probe. A fenestrated drainage-tube is now introduced at one opening and brought out at the other, and the ends of the tube secured, not by stitching them to the skin, as the stitches are liable to ulcerate through the skin in a week or so, but by the use of disinfected safety-pins.

The Lister dressing surrounding the joint must be sufficiently voluminous to absorb a considerable amount of fluid, especially for the first days after the operation.

The fluid injected to wash out the synovial cavity should be 2.5 to

3 per cent. solution of carbolic acid. The danger of retention of the fluid injected and consequent carbolic acid poisoning is not very great, as we are able, by well-known manipulations, to evacuate the fluid from the joint almost to the last drop, provided that no previous perforation of any of the bursæ of the joint has taken place.

As to the bandaging of the limb, we shall recommend Bonnet's white metal splint with lateral fenestræ, which we always use in excisions of the knee-joint, and of which an illustration was presented in a previous article on this subject.* The splint should be suspended from a wooden frame extending over the lower part of the bed.

It is impossible to state the exact time when the drainage-tubes may be taken out, and we must be guided by the absence of pus in the dressings or in the fluid evacuated from the synovial cavity in subsequent irrigations; in short, when no more pus forms in the synovial cavity, the drainage-tubes may be removed.

When, after the removal of the drainage-tubes, the incision wounds are healed and no fluid is contained within the capsule, we advise that a plaster cast be applied to immobilize the knee, and that the patient be allowed to be up on crutches, the shoe on the sound foot having a high sole, in order to prevent any weight from being borne on the leg operated upon. This procedure should be continued for the first two weeks In the course of time the patient will easily ascertain for himself when he may begin to rest weight on the limb operated upon.

After three to five weeks the plaster cast may be removed and passive movement of the joint commenced, which should be regulated by the condition of the joint, swelling, pain, etc., which should serve as a guide to all further steps in the after-treatment.

2. ANKLE-JOINT

The anatomic conditions of the ankle-joint are not so favorable as those of the knee-joint, as far as complete evacuation and efficient drainage are concerned, because in the natural position of the foot the capsule forms a pocket on both the anterior and posterior surface of the joint. We believe we have to attribute to these anatomic conditions the less favorable results, not as to the life of the patient nor the conservation of the limb, but as to the course of the inflammation and the future use of the joint. As examples we here present the following 3 cases:

CASE I (Fenger, 1880).—*Synopsis.—Suppurative synovitis of left ankle-joint subsequent to acute polyarticular rheumatism. Fever and considerable pain. Double incision into the joint at the anterior border of both malleoli. Drainage with soft-rubber tube. Washing out with 2.5 per cent. solution of carbolic acid. Rapid decrease in temperature and cessation of pain. Drainage-tubes removed in six weeks. Wounds healed ten days later. After three months patient discharged from hospital at her own request with limited mobility and pain in the joint.*

Maggie Brennan, aged thirty-seven, Irish, washerwoman, was transferred from the medical to the surgical side of Cook County Hospital July 20, 1880. She had been suffering from and under treatment for polyarticular rheumatism. On examination, the inflammation of the joints was found to have subsided excepting in the left ankle-joint, in which there were considerable pain, swelling, fluctuation on the anterior side of both malleoli, red, hot skin, on which, anterior to the external malleolus, was a place where the skin was very thin and yellowish from the subjacent pus shining through.

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* Chicago Medical Journal and Examiner, 1880, vol. xli, p. 7.

July 25th: Pulse, 86; temperature, 102° F. As the pain was intense and suppuration in the joint evident, the patient was anesthetized and Dr. Fenger opened the ankle-joint by means of incisions on each side of the joint anterior to the malleoli. After a certain amount of pus had been evacuated, a drainage-tube was passed through, stitched to the skin, and the joint cavity washed out with 2.5 per cent. solution of carbolic acid, and a Lister dressing applied.

July 26th: Pulse, 92; temperature, 99.7° F. Wound dressed under spray. Only a slight discharge from the drainage-tube.

August 15th: The ankle was placed in a fracture-box.

September 5th: Drainage-tubes removed. No discharge on the dressings.

September 15th: Wounds healed. There were still swelling behind both malleoli and pain on moving the joint. Plaster-of-Paris cast applied over the foot and leg, extending half-way to the knee. The patient out of bed on crutches.

In November the patient was discharged from the hospital at her own request, with a newly applied plaster-of-Paris cast. There was still stiffness in the joint and pain when any weight was borne on the foot.

The immediate effect of the operation in this case was perfect, as the fever and pain were at once relieved. But the effect upon the suppuration in the articular cavity was not nearly so marked as in the knee-joint, as it will be seen that the drainage-tubes had to be left in for six weeks before the formation of pus came to an end. And after the wounds were healed, it will be noticed that there was still swelling of the soft parts of the joint and tenderness on trying to bear weight on the limb, and this condition persisted even as late as three months after the operation. From this we think that insufficient drainage was the cause of the imperfect result. This is even more clearly shown in the following case:

CASE II (Fenger, 1879).—*Synopsis.—Chronic arthritis of ankle-joint subsequent to traumatic injury. Six months later, exacerbation of arthritis and suppuration in cavity of joint. Double anterior incision into cavity of joint. Drainage and washing out. Cessation of pain. Drainage-tubes removed in a week. One month later opening of abscesses posterior to the joint. After healing of wounds, chronic arthritis still present. Slow progress toward recovery, which is not yet perfect.*

P. G. Begley, aged thirty-two, laborer. Patient always had good health until April, 1879, when a plank struck him while at work on the external side of the ankle-joint. This injury was immediately followed by swelling and discoloration, which subsided after two weeks. After the injury the patient stayed at home two days only, and then walked about with pain, which disappeared in about a month. When walking he felt no pain, but when he would start to run, he felt pain in the joint.

Three months later swelling and pain anterior to the external malleolus set in and became so severe that he was obliged to quit work. Various salves, elastic bandages, etc., were employed, but the swelling and pain increased so that he was entirely unable to walk. In September he entered Cook County Hospital and remained there for six weeks. Hot fomentations and blisters were of no avail. The swelling increased and the pain become so severe as to make sleep impossible, notwithstanding the free use of opiates.

November 11th: The patient came under Dr. Fenger's care. He lay in bed, unable to move the limb. The ankle-joint was considerably swollen, with fluctuation from one malleolus to the other. The covering skin was red; the pain was so intense as not to permit sleep; no fever.

November 15th: Dr. Fenger, assisted by Dr. J. M. Bergen, at that time house surgeon, proceeded to operate. The patient was anesthetized, the region of the joint disinfected, and, under the carbolic spray, an incision was made in the joint anterior to the external malleolus. About an ounce of pus escaped. No denuded bone could be felt when a probe was introduced into the cavity of the joint. The probe was then forced through the joint toward the anterior side of the internal malleolus, and an incision made on the point of the probe. A drainage-tube was introduced at one opening and brought out at the other and stitched to the skin. The joint was washed out with 2.5 per cent. solution of carbolic acid, dressed antiseptically, and placed in a blanket splint.

Subsequent to the operation the pain ceased entirely, and the discharge stopped in about a week, so that the drainage-tube was removed.

About a month later a painful swelling formed posterior to the external malleolus, and December 19th an incision was made, with the evacuation of ½ ounce of pus, and a drainage-tube inserted. This cutaneous pain stopped and the drainage-tube was removed in two weeks, but recovery was slow; the patient fell into the hands of quacks, who for several months applied salves, etc.

Half a year later, in the summer of 1880, Dr. Fenger was called to see the patient. He found the wounds healed, but an area of elastic swelling in the region of the joint, most marked on the posterior side, behind the malleoli. Motion was limited, and when exaggerated, produced pain. No pain on pressure, but the patient was not yet able to bear any weight upon the foot. A plaster-of-Paris bandage was applied, and the patient allowed to walk about on crutches, but not allowed to put his foot to the ground.

Six months later, January, 1881, the swelling and tenderness had decreased considerably. Dorsal and plantar flexion to an extent of about 20 degrees was possible, but the patient was still unable to bear any weight upon the foot.

In this case the immediate effect of the operation, as far as relief of the pain was concerned, was perfect, but the insufficient drainage by anterior incisions alone was clearly shown by the subsequent formation of an abscess on the posterior aspect of the joint. A proposed double incision and drainage on the posterior side of the joint were not permitted by the patient.

CASE III (Lee, 1880).—*Synopsis.—Suppurative synovitis in ankle-joint of a scrofulous individual with previous suppuration in an elbow-joint terminating in ankylosis. Anterior opening and drainage of the ankle-joint. Several relapses following the removal of drainage-tubes, relieved by opening and draining anew. Progress of caries of the bones of the joint, necessitating excision. Further progress of caries finally necessitating amputation.*

Annie Sweeney. The patient was transferred on September 21, 1880, from the medical side of Cook County Hospital, where she had been treated for a so-called rheumatic inflammation in the right ankle-joint, to the surgical side, and placed under the care of Dr. Lee. Two months previous she took off her woolen stockings and thinks she took cold. In consequence of this there was an exacerbation of pain in the ankle, accompanied by swelling, which terminated in suppuration, as was revealed by the exploring needle. On examination, the ankle-joint was found tender and swollen, and pus was obtained with the exploring needle.

September 25th: Operation. The joint was opened by Dr. Lee in front of the malleoli, and a drainage-tube passed through the anterior surface of the joint, which was washed out with a 2.5 per cent. solution of carbolic acid and dressed antiseptically.

September 26th: The joint was washed out. Very little pus in the dressings.

October 2d: No pain; slight discharge.

October 8th: Drainage-tubes removed; horsehair drains introduced; patient feels well.

October 15th: Horsehair drains removed; wounds nearly healed.

October 20th: Wounds healed.

October 22d: Reappearance of the trouble at the outer surface of the ankle-joint, which is red, swollen, and tender. The patient is feverish; tongue furred; appetite gone.

October 24th: Fluctuation at the outer surface of the ankle-joint. An incision was made and a drainage-tube inserted.

November 1st: Wound discharging freely.

November 11th: Wound healing.

November 24th: Drainage-tube removed.

December 3d: Wound entirely healed.

December 16th: The patient is able to get up and walk with a crutch.

December 18th: Complains of severe pain at the outer side of the ankle-joint.

January 1, 1881: Sinus on the outer side of the ankle-joint reopened. The introduction of a probe revealed carious bone at the bottom of the sinus.

January 23d: Enlarged sinus, introduced drainage-tube, and washed out the joint with 2.5 per cent. solution of carbolic acid.

In the course of the following week the swelling, pain, and discharge continued, so as to necessitate excision of the joint, which was performed February 11th by Dr. Fenger, the report of which will be given in a succeeding paper, embracing the reports of a number of excisions of the large joints.

This case is in conformity with the two cases reported above, so far as the insufficient result of the treatment of suppurating ankle-joints by anterior incision alone is concerned, but shows in a marked degree the immediate relief of the fever and pain from the drainage and washing out, as well as the fact, stated above, that this surgical procedure enables us to try to save the joint, and when this becomes impossible, at last to make the excision. During the above course of relatively expectant treatment the life and health of the patient are not endangered to an unreasonable extent.

As a result of our experience of these last cases we shall recommend for future trial the following treatment of suppurating ankle-joints:

The first incision should be made just anterior to the external malleolus, into the suppurating articular cavity. Through this opening a probe should be passed through the anterior side of the joint inward toward the anterior border of the internal malleolus, the point of the probe being pushed toward the skin so that it may serve as guide for the incision for the counteropening.

A fenestrated soft-rubber drainage-tube should now be fastened to the eye of a probe, and by this means passed through the anterior side of the joint, and the drainage-tube held in place by small disinfected safety-pins.

The next step in the operation should be to pass a drainage-tube through the posterior side of the joint, in a similar way, behind the malleoli. The first incision should be made behind the external malleolus, close to the tibia, into the joint, and the probe passed through inward toward the posterior border of the internal malleolus until it points against the skin, so that a counterincision may be made upon the point of the probe.

Experiments upon dead bodies have shown us that a counteropening, cautiously made in this way upon the point of the probe, pointing through the skin and parallel to the posterior border of the internal malleolus, may be made safely without dividing the posterior tibial artery.

A drainage-tube is then passed through the posterior sac of the joint in the same way as already described for the anterior sac.

In this way we think it will be possible to establish a sufficient drainage and washing out, the results of which will, of course, have to be shown by future experience.

There is no comprehensible reason why the drainage of the posterior sac, in addition to the drainage of the anterior sac, should involve any additional danger to the operative treatment of suppurating ankle-joints if all antiseptic precautions are strictly adhered to. We think, consequently, that we are justified in the hope that this treatment may give just the same results for the ankle-joint as for the knee-joint.

In conclusion, we shall make only a few remarks regarding the benefits which may reasonably be expected to be derived from this surgical treatment of suppurative synovitis.

The first effect of the operation will invariably be the relief of the pain and checking of the fever, effected probably by relieving the tension caused by the accumulation of pus in the articular cavity. In doing this we may reasonably expect to prevent rupture of the capsule and periarticular abscesses.

In checking the suppuration by washing out the cavity we may expect to prevent further destruction of the cartilaginous covering of the articular surfaces of the bones, and thus hope to secure a certain degree of mobility of the joint.

It would be a mistake, however, to measure the value of the operation by its results as regards the future mobility of the joint in question, as this will depend entirely upon the nature of the disease of the joint at the moment of operation. It has been established by general experience that an acute superficial suppurative synovitis, when operated upon sufficiently early, gives a far better prospect of a movable joint after the operation than does a suppurative synovitis which constitutes only an acute shock in a chronic arthritis.

The reasons for this are easily determined. The chronic arthritis will necessarily have caused deeper pathologic changes in the capsule and articular surfaces previous to the time of the acute shock requiring the operation.

That this view is correct is still further shown by the experience of Schede, who tried the opening, drainage, and washing out of joints affected with fungous, that is, in most cases, tuberculous, arthritis, combined with scraping out the joint by means of the sharp spoon.

He found that no benefit was derived from this treatment in these cases.

In consequence of this it seems that, for the time being, the operation must be limited to cases of suppurative synovitis.

We may finally state that the operation, when all antiseptic precautions are scrupulously adhered to, is entirely free from danger. None of Schede's patients, either in the acute or chronic cases, experienced any dangerous consequences from the operation.

A similar treatment of 26 cases of severe traumatic injuries to joints, published by Ranke in 1878,* was not followed by fatal results in a single case.

We are, consequently, justified in regarding the operation as a surgical measure, from which benefit alone can be derived, the amount of which does not depend so much upon the operation as upon the stage and character of the disease of the joint to be operated upon.

But, at the same time, we must bear in mind that the surgeon who is not thoroughly familiar with and able to master the antiseptic method has no right to avail himself of the benefits of this radical treatment of suppurating joints, because the omission of any of the antiseptic precautions will jeopardize the patient's life and make the operation as dangerous as our forefathers rightly regarded it.

* Virchow-Hirsch Jahresbericht, Berlin, 1879, vol. ii, p. 356.

SUPRAMALLEOLAR OSTEOTOMY FOR OUTWARD DEVIATION OF THE FOOT, SUBSEQUENT TO POTT'S FRACTURE HEALED UP IN A BAD POSITION *

THE operation of osteotomy, introduced into surgery as a means of correcting deviations in the shape and direction of the extremities in cases in which this deviation was an essential hindrance to the use of the limb thus affected, was first systematized by von Langenbeck in 1852 for ankylosis in false position of the hip- and knee-joints.

The operation was performed according to the so-called subcutaneous method, that is, through the smallest possible opening in the skin a fine saw was passed in upon the bone, and this cut through, the false position corrected, and the cut surfaces of the bone left to unite in the same way as in a common fracture. The small opening in the skin had for its object the prevention of suppuration. The subcutaneous operation of tenotomy has the same object. These precautions were natural and necessary prior to the advent of antiseptic operating and dressing.

A step in advance was made by Gross, of Philadelphia, in 1861, who rendered the operation more easy of performance by substituting the chisel for the saw.

Since this period, that is, for the last twenty years, osteotomy has been a common operation for the correction of the various deviations of the bones of the extremities arising from rachitis, ankylosis of the joints, fracture healed up in a bad position, or from any other cause.

Even before the Lister method was known in surgery and employed in osteotomy relatively little danger was connected with the operation. In most of the cases operated upon the limbs healed in a correct position, just as they would after a common subcutaneous fracture; but sometimes suppuration would set in, and even erysipelas and pyemia could not be entirely excluded.

The fear of these complications deterred the profession in general from recommending or making use of the operation in all cases in which it would prove of essential benefit, and, we may say, limited the operation to those cases in which it was imperatively necessary.

The antiseptic method of operating and dressing has done away with this drawback in the indications for the operation, and at the same time has rendered the so-called subcutaneous operation unnecessary. We are now able to cut without fear through the soft parts covering

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* Medical News, 1882, vol. xl, pp. 398, 427.

the bone to be divided, making as large an incision as is necessary to cut through the osseous tissue with ease and safety. Through this opening we can make an incision in the periosteum, denude as much of the surface of the bone as is necessary, cut out by means of saw, chisel, and hammer a piece of bone of the exact size and shape we require, unite the osseous surfaces with silver sutures if we deem it advisable, and, in fact, operate with perfect safety and security, allowing sufficient time for all the details of the operation, because we know that we are protected by antiseptic precautions, by which the healing by first intention of a wound, whether large or small, is accomplished with equal rapidity and safety.

We must bear in mind, however, that this wider field in the indications for the operation which has been opened up by the Lister method at the same time places an increased amount of responsibility upon the operator, since he now is held responsible for all septic accidents which might occur subsequent to the operation.

When all antiseptic precautions are taken, down to the most minute details, during the operation and in the course of the after-treatment, and carried through systematically, there can be no more danger than in subcutaneous osteotomy.

It was with this conviction that I did not hesitate to extend the employment of osteotomy to cases of false position of the foot following Pott's fracture. In these cases there is no vital indication for the operation, as such patients are able to limp about, with or without the use of a cane; but the deviation of the foot impairs their walking so considerably that a large number, particularly of the lower class of the people, are thereby unable to earn a living, as many of them cannot learn or work at a trade in which walking or the free use of the lower extremities does not play an important part.

The following cases will show that supramalleolar osteotomy can be performed in such cases, not only without danger to the patient's life, but with the result of completely restoring the usefulness of the foot, so as to enable him to walk just as well as before the fracture and subsequent deviation had taken place.

CASE I.—*Outward deviation of left foot, subsequent to compound comminuted Pott's fracture in a syphilitic individual. Supramalleolar osteotomy, followed by suppuration. Union in eight weeks. Out of bed in nine weeks. Able to bear weight on foot in eleven weeks. Open sinuses for more than a year. Subsequent complete recovery, with perfect ease in walking.*

Henry H., a clerk thirty-eight years of age, was admitted to Cook County Hospital June 16, 1879. The patient had syphilis some years ago, but with this exception had been always healthy, until eighteen months previous to his entrance to the hospital, when, in St. Louis, Mo., he received an injury which caused a compound comminuted fracture and dislocation of the left ankle-joint. He was treated for five months in a hospital in St. Louis, and at the end of that time was able to walk about with a cane. On account of an outward deviation of the foot, however, walking was painful, and could be endured for only a very short time. In June an abscess formed around the internal malleolus, which was opened on admission and some pus evacuated. No denuded bone could be felt through the wound.

He left the hospital at his own request August 10th, the wound not yet being healed, but returned September 1st, suffering with increased swelling and pain, and was placed under my care.

Examination.—Patient is unable to walk on account of pain in the region of the left ankle-joint, at which point is found a Pott's fracture healed in a bad position, with outward deviation of the foot. The internal malleolus is very prominent, considerably enlarged, and covered on its inner surface with a layer of adherent cicatricial tissue. Above and exterior to the external malleolus is an irregularly shaped ulcer, about ¾ inch in diameter, with quite abrupt edges and an uneven floor, covered with grayish-red, discolored granulations, and secreting a large amount of thin, grayish pus. The surrounding skin is dark red, swollen, and tender.

The deformity of the foot (shown in Fig. 31) is the real cause of his inability to walk, as the line of gravity of the limb falls internal to the foot, or, in other words, the foot is in a position of dislocation outside of the line of gravity; that is, the line of gravity of the foot forms an angle with the line of gravity of the limb, which opens outward, and in which the apex of the angle corresponds to the base of the internal malleolus, the seat of the old Pott's fracture.

To remedy this deformity—after careful investigation upon the cadaver as to the best method of performing osteotomy in such cases —I devised the following operation:

September 12th: I operated, assisted by Dr. Sawyers, and in the presence of Drs. Gunn, Isham, Jacobson, and Lee. The patient was anesthetized with ether. A transverse semilunar incision was made over the inner surface of the inferior extremity of the tibia, 2 inches above the apex of the internal malleolus, through the skin and subcutaneous tissue, being careful not to open the sheaths of the tendons of the anterior and posterior tibialis muscles. A transverse incision was then made through the periosteum, and a short longitudinal incision on either end of this. The two flaps of periosteum were separated from the bone with a gouge, and a base ¾ inch in width was marked out with a saw, for a wedge-shaped piece of bone, which was cut out by means of hammer and chisel, the point of the wedge being at the external border of the tibia. The attempt was now made to reduce the deformity by taking the foot in the right hand and bending it over the knee. While reducing this deformity the fibula fractured at about 1 inch below the cut through the tibia, and the upper fragment of the external malleolus broke out through the ulcer described above, thus making a compound complicated fracture which extended into the ankle-joint. The external malleolus was the seat of a diffuse osteoporotic osteitis, and consequently the osseous tissue at this point was very fragile. The remaining part of the diseased malleolus was now removed, the cut surfaces of the tibia approximated and secured by strong silver wire sutures, a drainage-tube inserted, the wound closed by sutures, and a Lister dressing applied.

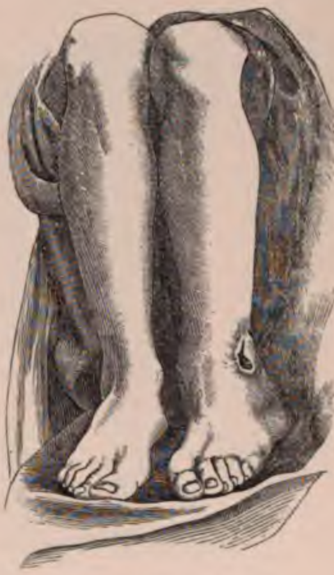

Fig. 31.—Deformity of foot.

The leg was then placed in an apparatus devised for the purpose, which consisted of a padded leather band around the upper part of the calf, which contained a heavy steel bar that came down on the external side of the foot, bearing a foot-piece, which was inverted and kept in place by a strap on the inner aspect of the leg. The steel bar, when passing over the external malleolus, was bent out so as to permit the application of Lister dressings around the ankle-joint without removing the apparatus. The band was secured around the leg by leather straps and buckles, and the foot fixed to the foot-piece by roller bandages. The whole apparatus was suspended in a Hodgen's anterior splint.

September 13th: A little hemorrhage occurred during the night, with some pain.

September 14th: Wound dressed; no suppuration.

September 16th: Wound dressed; very little suppuration, but considerable pain. Applied ice-bag over the dressing.

October 8th: For the last two weeks he has had no pain. The wounds, over both the tibia and the fibula, are granulating somewhat luxuriously. Touched with nitrate of silver.

October 18th: Wound dressed. Foot seems to be turned inward a little too much. A compress and bandage was, therefore, applied to correct the position, but this caused the patient so much pain that it was discontinued.

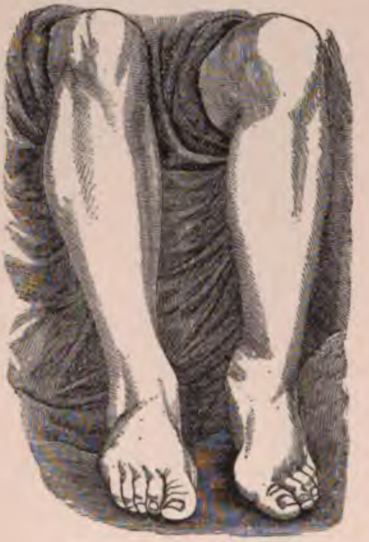

Fig. 32.—Result of operation.

October 22d: Wound dressed. The wound seems to have come to a standstill as regards healing, being covered with soft, pulpy, jelly-like granulations, which were cauterized thoroughly with silver nitrate.

October 23d: A small piece of dead bone came out from the wound over the external malleolus.

October 26th: The splint was removed, in order to be used as a pattern in making a splint for a patient upon whom Dr. Gunn was about to perform a similar operation for the same deformity. The leg was placed in a Hodgen's splint.

October 29th: Another small piece of dead bone was taken out. The patient has had some diarrhea. The wounds showed no tendency to heal, and were covered with a thick, grayish, croupous exudate. Cauterized with silver nitrate.

November 5th: The wound is looking better, and the silver wire is removed.

November 12th: Removed the frame and suspension apparatus, and the limb was placed in a fracture-box.

December 4th: For the last two days the patient has had pain around the external malleolus, behind which was a small abscess, which was opened and washed out.

December 11th: On account of the discharge the wound has to be dressed every day.

December 15th: The discharge ceased, and the patient got up and walked about a little on crutches.

December 25th: Is up most of the day, and can walk a few steps without crutches. Two sinuses lead to the denuded bone.

January 17, 1880: All the sinuses are nearly closed, but there is still some swelling.

January 23d: A small abscess opened, through which a probe can be passed in deep within the bones.

March 1st: The wound is healing up on both sides with very little discharge.

April 2d: A discharging sinus from the cavity within the tibia was cauterized, three small fragments of bone extracted, the cavity filled with boric acid, and a drainage-tube inserted.

March 15, 1881: The last of the superficial ulcers healed, and the position of the foot was straight (as is shown in Fig. 32). The tendo Achillis is in the usual straight line, and upon bearing the weight of the body on the foot no deviation is noticeable. The patient walks two to three miles without inconvenience and without the use of a cane. The inferior extremity of the tibia is still somewhat enlarged, and there is some tenderness on pressure on its surface.

May 7th: From time to time superficial ulcerations have formed, not upon the cicatricial tissue of the wounds of operation, but below this, on the cicatrix of the original wound caused by the compound fracture. Mobility in the ankle-joint is still somewhat limited, but this does not prevent him from walking without a cane and without limping.

As far as the bones operated upon are concerned, the final result of the operation is perfect, but the long convalescence in the case is an exception, and was due to the specific chronic disease in the bones operated upon.

In uncomplicated cases, in which the patient's health is good and the osseous tissue at the seat of the operation normal, the time for the healing of the cut surfaces of the bones and the osteotomy wound will not greatly exceed the usual limited number of weeks required for the recovery from a common subcutaneous Pott's fracture. This I intend to show by the following cases:

CASE II.—*Outward deviation of left foot subsequent to Pott's fracture. Operation four months later. Aseptic course without suppuration. Eight days later, drainage-tubes removed. Perfect osseous union in four weeks. Complete recovery.* (Fenger, Chicago, 1880.)

John B., Irish, aged thirty-eight, a painter, was admitted to Cook County Hospital July 14, 1880. He had previously had good health. On April 15th he was seated beside a tree, eating dinner, and got up suddenly; in so doing he put his left foot into his dinner pail; his right foot slipped, throwing his weight on the left foot, which turned outward and upward, causing him much pain. A physician was called, who pronounced the injury a fracture. At this time the foot was turned outward and upward until it was nearly at right angles with the leg. It was placed in loose dressings for a week, after which a starch bandage was applied, which was continued for four weeks. The patient remained in bed for more than four weeks, and was then allowed to be up on crutches, but was not yet able to bear his weight on the foot. Consequently, four and one-half months after the receipt of the injury, the patient entered Cook County Hospital and was placed in my care.

On admission the patient was unable to walk without the aid of a cane. He could not bear weight on the foot without intense pain. The same deformity existed which has already been illustrated in Case I; that is, the foot was in a position of outward subluxation; the line of gravity of the limb, instead of being continuous with the line of gravity of the foot, formed, with the latter, an angle of from 30 to 35 degrees, the apex of the angle being at the base of the internal malleolus.

August 13th: The patient having been anesthetized with ether, I proceeded to perform osteotomy, following the same plan devised in Case I, namely, a transverse incision was made across the lower extremity of the internal surface of the tibia, about 1¾ inches above the apex of the internal malleolus. The skin, subcutaneous tissue, and periosteum were divided, the periosteal incision being in the shape of an H, having an elongated cross-bar. The two narrow flaps of periosteum were now loosened from the bone. A narrow retractor was inserted between the periosteum and the bone, so as to avoid opening the sheath of the tendons of the tibialis anticus and posticus. Two parallel transverse incisions were made through the periosteum of the lower end of the tibia, distant about four lines from each other. With hammer and chisel a wedge-shaped piece of bone was cut out through the whole thickness of the bone, the apex of the wedge being the cortical substance of the external surface of the tibia. The fibula was perforated by means of a drill in different directions, but on the same horizontal plane. I now grasped the foot with my right hand, pressed my knee against the internal surface of the tibia, from which the wedge of bone had been cut out, and made powerful traction until the bones fractured. This restored the foot to its normal position, in which the cut surfaces of the tibia were in apposition. This position was maintained by means of sutures of heavy silver wire through the bone. A small drainage-tube was now inserted, the wound in the skin united, a Lister dressing applied, the leg placed in Dr. Verity's modification of my original apparatus for the dressing and suspension of the foot in the after-treatment of supramalleolar osteotomy, and the patient placed in a tent in the grounds of the hospital.

August 15th: Pulse, 90; temperature, 99.5° F. Wound dressed. No redness, swelling, or suppuration.

August 16th: Pulse, 93; temperature, 99.4° F. The patient suffers some pain in the wound. This was controlled by morphin.

August 21st: The wound is now superficial. It was dressed; very little discharge. The drainage-tube was removed.

September 1st: The silver sutures were removed, and the foot placed in a fracture-box filled with oakum.

September 11th: Firm union of the bony surfaces. The foot was taken out of the fracture-box and placed in a blanket splint. The wound is still superficially granulating.

October 2d: The dressing was removed, and the wound found to be healed. A plaster cast was applied, and the patient allowed to be up on crutches.

October 11th: The patient wears the plaster cast continually, is gaining strength rapidly, and is now commencing to bear weight on the foot.

October 18th: The patient was discharged from the hospital at his own request.

During the whole course of the after-treatment the patient's temperature never exceeded 100° F.

In January, 1881, I received a letter from the patient, who was then in Wisconsin, asking advice in regard to a cough. In the letter he stated that he was then able to bear his weight on the foot and walk about without any trace of his former complaints.

CASE III.—*Outward deviation of right foot, of ten years' standing, from Pott's fracture. Operation. Five weeks later dressings removed. Seven weeks later can bear weight on foot. Complete recovery.* (Verity, 1881.)

William B. W., a groceryman, fifty-three years of age, was admitted to Cook County Hospital January 19, 1881, suffering from suppuration of the metatarsophalangeal articulation of the great toe of the right foot, caused by frost-bite.

The patient has for many years been addicted to the excessive use of liquor. During the past year he has taken from 10 to 20 drinks daily. He has had syphilis. Ten years ago, while in Colorado, he sustained a Pott's fracture, which in default of proper care healed up in a bad position.

On admission the patient was found to be well nourished. The right foot was turned outward at an angle of about 30 degrees.

February 20th: After the usual course of treatment preparatory to an operation for the restoration of the contour of the limb, the patient was anesthetized with ether, and after the application of Esmarch's bandage Dr. Verity, the house surgeon, performed the operation. A longitudinal incision was made, beginning 3 inches above the internal malleolus, and extending to its extreme point. The soft parts were widely separated by retractors. A transverse incision was made through the periosteum, 1½ inches above the lower extremity of the tibia. Two longitudinal incisions, perpendicular to the first incision, were then made through the periosteum, making altogether an H-shaped incision. The periosteum was now carefully retracted, laying bare a portion of bone about 1¼ inches long and ½ inch in breadth. A base having first been marked out, a wedge-shaped piece of bone was cut out from the tibia with a hammer and chisel, the base of the wedge being inward, and the apex pointing outward at an angle equal to and compensating the angle of deformity. The cut ends of the tibia were now approximated and united by a heavy silver suture, the fibula having first been bored through in order to facilitate its fracture. A drainage-tube was inserted, the wound closed by aseptic silk sutures, and a Lister dressing applied. Verity's modification of my osteotomy splint was now applied over a plaster-of-Paris cast, embracing the upper two-thirds of the leg and lower two-thirds of the thigh, the leg being flexed upon the thigh at an angle of about 45 degrees, in order to give greater leverage and prevent rotation of the foot, and the leg suspended.

The wound was dressed every two or three days and healed kindly. The temperature reached 101° F. on only one occasion.

March 28th: Dressing removed. The patient can move around with the aid of crutch and cane.

April 10th: He can bear considerable weight on the foot.

April 20th: He is able to walk with a cane and has done some light work in the ward.

May 2d: At his own request the patient was discharged from the hospital cured.

This supramalleolar osteotomy is not any more or any less dangerous than osteotomy in any other location, and it is in the power of the operating surgeon to reduce the danger to a trifling minimum by means of strict antisepsis.

As regards the method of operating, we shall make the following remarks, based upon careful observations upon the cadaver, made by me prior to the performance of my first operation:

It is essential not to open the ankle-joint, that is, to have no communication whatever from the cut osseous surfaces, or even from the incision through the soft parts to the joint, for the following reasons: First, suppuration may take place when there is an osteitis in the bones operated upon in spite of all antiseptic precautions; and, second, thorough drainage of the ankle-joint is so difficult that suppuration in this location cannot be combated with as great ease as in the knee-joint.

The operation has been so minutely described in the report of Case I that recapitulation will be unnecessary. We shall, therefore, mention certain points only in regard to the operation.

The cutaneous incision we shall recommend to be longitudinal, 2½ to 3 inches in length, in the middle of the medial surface of the lower extremity of the tibia (as was done in Dr. Verity's case). The transverse incision through the periosteum should be 2 inches above the apex of the internal malleolus. The 2 incisions in the periosteum perpendicular to that last mentioned should be from ¾ inch to 1 inch long. Care should be taken not to open the sheaths of the tendons of the tibialis anticus and posticus.

It is needless to state that the size of the base of the wedge of bone to be cut out depends on the degree of the deformity, but from the cases operated upon we think that from 10 to 15 mm. will include the average width. It is advisable to define the base of the wedge by two transverse cuts through the cortical substance by means of a small saw, so as to avoid unnecessary splintering of the cortical substance by the chisel. In cutting out the wedge care should be taken at the anterior and posterior cortical surfaces to avoid opening the sheaths of the tendons with the chisel.

It would be impossible to perform this part of the operation with perfect exactness, if we could not, by means of Esmarch's bandage, make the operation bloodless, but with the bandage and a good light this part of the operation can now be done with exactness, the sheaths of the tendons having first been retracted.

A common carpenter's chisel is preferable to the so-called surgical chisel, because the extremity of the latter forms the apex of an isosceles triangle, while the extremity of the former forms the apex of a right-angled triangle. The carpenter's chisel is the only one which permits the cutting out of a wedge of bone of the exact shape and size required.

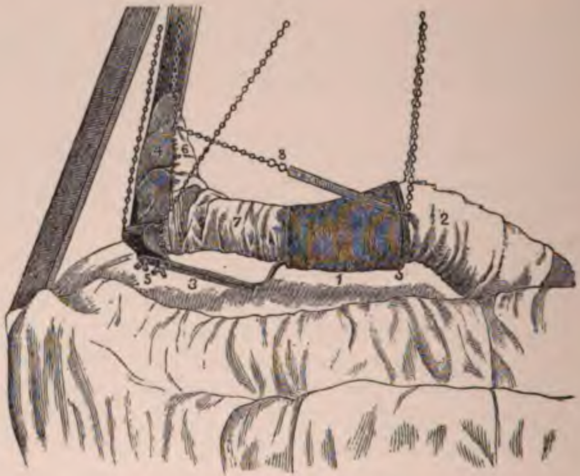

Fig. 33.—Apparatus for immobilization.

The point of the wedge will be the cortical substance of the lateral surface of the epiphysis. This need not be divided, but should be simply fractured, as no osseous substance here needs to be removed.

The drilling of the fibula—at a point corresponding to the incision through the tibia, and which we wish to fracture—may be done through so small a cutaneous opening as to permit the passage of the drill only, and not to require drainage.

It requires a moderate degree of force, after the bones have been cut, to restore the foot to its normal position. If there is too much resistance, it is evident that either the chiseling of the tibia or drilling of the fibula has not been sufficiently thorough, and, consequently, must be completed.

It is advisable to unite the cut surfaces of the tibia by a suture of heavy wire, because here, as in any other fracture, perfect immobility facilitates osseous union.

The main difficulty in the after-treatment is to keep the parts absolutely immobile, and, at the same time, permit the application of the necessarily voluminous antiseptic dressing. This was accomplished by the apparatus shown in Fig. 33, as devised by Dr. Verity and used in his case.

This consists of a broad leather band (1), secured around the upper part of the calf of the leg, outside of a plaster-of-Paris cast (2), extending from the middle of the thigh to the middle of the calf. The plaster cast prevents excess of pressure from tightening the leather band. A steel bar (3) extends down the posterior side of the leg, and has attached to it a movable foot-piece (4), which may be fixed in any desired position by means of screws (5). The foot is attached to the foot-piece by a plaster-of-Paris bandage (6). This apparatus allows, as will be readily seen, ample room for the antiseptic dressing (7), which can be changed without the least movement of the leg, which is suspended from a wooden frame. The adduction of the foot is further secured by a cord (8) from the inner side of the extremity of the foot-piece to the inner side of the leather band.

The cases above mentioned have demonstrated that supramalleolar osteotomy is a justifiable procedure: first, because it perfectly restores the proper function of the foot, and, second, because the inconveniences or dangers subsequent to the properly managed operation do not constitute an insurmountable barrier against the advantages obtainable.

It is to be hoped, however, that the indications for the operation will be more and more rarely met with, as deformity is avoidable by proper management of Pott's fractures. Not less than four cases of this deformity have applied for aid at Cook County Hospital within the last three years. (Dr. Gunn performed the operation in the fourth case.) It seems natural to conclude that such cases are, as yet, not so very uncommon. If this is the case, the operation may prove to be of some practical value, which will entitle it to a trial by the profession.

SIX CASES OF ANEURISM*

WITH E. W. LEE, M.D.

As the title indicates, this paper is simply a casuistic report, which we desire to lay before the Society. The number of cases is so small, and their nature so different, that the subject of aneurisms in general cannot be considered here.

We do not need to state that while the general term, aneurism, is perfectly correct anatomically, it is altogether too general when location, symptomatology, therapeutics, and cure are taken into consideration. The necessity of individualization in this respect has been mentioned in only very few of even the more elaborate hand-books of surgery. Attention must be given to this important point in future. This individualization can be accomplished only by a large number of casuistic reports, and to this end our paper of tonight is intended as a small contribution. To counterbalance the necessary dryness of the bare casuistic reports, we have added some remarks intended to point out some of the practical points of unusual interest to which our attention has been directed in some of the cases.

CASE I.—*Traumatic Popliteal Aneurism.* (Fenger, 1881.)—*Synopsis.—Traumatic left popliteal aneurism from revolver bullet, wound passing through the artery. No external hemorrhage. Ligation of the popliteal artery* in loco. *Gangrene. Amputation at upper third of thigh. Death.*

J. M., a laborer, thirty-five years of age, was brought to Cook County Hospital July 5, 1881, and placed under Dr. Fenger's care. On admission he gave the following history:

July 4th, while walking across State Street, he felt a sudden pain in the left popliteal region; simultaneously he heard the report of a revolver which had been fired from a group of boys on the sidewalk. He was able to walk home, but pain and a feeling of tension in the popliteal space soon rendered walking difficult and compelled him to lie down. A small wound could be seen at the lower extremity of the outer hamstring tendon, from which, however, there was only very slight hemorrhage. The pain and swelling increased during the night, and the next morning, as he was unable to walk, he was brought to the hospital.

Examination revealed a revolver bullet wound an inch above the head of the fibula, close to the tendon of the biceps. Severe pain in the leg, which is slightly flexed at the knee, and the slightest movement of which is painful. The capsule contains no fluid, and there is no swelling on the anterior side of the limb, but the popliteal space is swollen, tense, and tender. The swelling extends downward through the upper third of the calf, and upward through the lower third of the posterior side of the thigh.

The hand applied over the popliteal space feels distinct pulsation, and the stethoscope reveals an unmistakable aneurismal bruit, most pronounced in the middle of the popliteal space.

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* Gaillard's Med. Jour., 1882, vol. xxxv, p. 1. Read before the Chicago Biological Society, February 1, 1882.

Diagnosis.—Traumatic aneurism of the popliteal artery from revolver bullet wound.

Plan of Operation.—Ligation of the wounded artery *in loco.*

July 5th: In the afternoon the patient was anesthetized, turned on his face, and Esmarch's bandage applied as high as the upper third of the femur, where the elastic constriction was made. A longitudinal incision, four inches in length, was made in the middle line of the popliteal space, through the skin, subcutaneous tissue, and fascia. Below the latter, in the adipose tissue surrounding the large nerves and vessels, was a profuse extravasation of dark, clotted blood, extending above and below the ends of the incision. A probe introduced through the entrance opening of the bullet wound could be passed transversely through the popliteal space from the external to the median border, where it was stopped in the muscular mass of the internal head of the gastrocnemius.

Leaving the probe in this position, careful dissection was made with the dissecting forceps, so as to avoid injuring any vessels, and after the removal of several small clots it was found that the nerve and the popliteal vein were intact, but the artery was perforated twice, one opening being lateral and one median. Through these openings the probe passed transversely through the lumen of the artery. At the end of the wound, in the inner head of the gastrocnemius, a small revolver bullet, 32 caliber, was found and extracted. The artery was now easily isolated and ligated above and below the two perforations, the ligatures being at a distance of less than half an inch from each other.

No signs of suppuration were to be seen in the tissues after the removal of the clots. The constriction around the femur was removed; a trifling hemorrhage followed, which was checked by irrigation; a drainage-tube inserted; the wound united; Lister dressing applied; the leg placed in a Bonnet splint, slightly flexed at the knee, and suspended in an elevated position.

July 6th: Pulse, 108; temperature, 102.1° F. Patient has been restless during the night. The crus and foot are somewhat swollen and painful, but warm, and have a slight yellowish discoloration.

July 7th: Pulse, 110; temperature, 102.5° F. The swelling of the foot and crus has increased. The skin has a diffuse, yellowish-brown discoloration, and several brownish-red bullæ, from the size of a pea to that of a hazelnut, are spread over its surface. The discoloration now extends from the crus up over the median line of the knee-joint, along the track of the vena saphena major. Dr. Fenger proposed to the patient immediate amputation in the middle of the thigh as a possible means of saving his life from the rapidly spreading moist gangrene, but the patient positively refused to submit to the operation, as he had no pain and was able to move the foot.

July 8th: Pulse, 120, weak; temperature, 102° F. The discoloration along the vena saphena major now extends to the upper third of the thigh. The patient now consented to amputation, and consequently amputation at the upper third of the thigh was performed, with a large external and small internal flap, taken from apparently healthy tissue. The operation was accompanied by the usual amount of hemorrhage. The stump was dressed antiseptically.

July 9th: Pulse, 130; temperature, 101° F. The patient rallied in due time after the operation and slept well during the night. With the exception of weakness, he feels well. As some brownish discoloration of the skin was seen in and above the inguinal region, the amputation wound was dressed, and showed gangrene spreading along the medial surface of the amputation stump.

July 10th: During yesterday afternoon the patient became weaker, collapsed, and died at 9 P. M.

The autopsy demonstrated the usual signs of moist gangrene, namely, a little cloudy serum infiltrating the subcutaneous tissue of the thigh and lower half of the left side of the abdomen; fluid blood; heart flabby from cloudy swelling; flabby and cloudy spleen, liver, and kidneys; all the other organs normal.

It was the conservative tendency of modern surgery, relying upon the antiseptic method, taken together with the rules laid down in modern works on surgery, that led Dr. Fenger to attempt to save the patient's limb in this case by double ligation *in loco*.

A discussion in the French Surgical Society in 1875 * concerning the treatment of wounds of the large arteries showed that the opinion of the majority of those present was that immediate double ligation of the wounded artery should be made in cases uncomplicated by injuries to, or inflammations of, the surrounding tissues.

Two cases of gunshot wound of the femoral artery, one from pistol bullet and one from buckshot, were reported from Volkmann's Clinic by Kraske, at the Eighth Congress of German Surgeons,† in each of which perfect and speedy recovery, with conservation of the limb, followed immediate double ligation. These results seem to strengthen the advisability of conservative surgery in such cases.

The popliteal artery has always had a bad reputation, on account of the dangerous character of its injuries, and Poland's opinion,‡ corroborated by Pollock's § after the treatment in all of ten cases, was that amputation was preferable to either double ligation *in loco* or ligation of the femoral artery, and that the amputation should be primary, as amputation after gangrene has commenced is always an uncertain operation. Only two of the cases cited by this author in which immediate double ligation was made recovered; in three cases gangrene followed.

The larger standard hand-books on surgery,—Pitha, Billroth, and Erichsen,—in the consideration of wounds of the popliteal artery, rather recommend than condemn the ligation *in loco* in suitable cases, which must, of course, be a minority.

In looking over the literature for the last fifteen years we have been able to find only one case, besides the two above-mentioned cases reported by Poland, in which the treatment of a wounded popliteal artery by ligation *in loco* was successful in saving the limb. This case was reported by Annandale.|| A boy ten years old suffered a punctured wound in the popliteal. Three months later a pulsating tumor was noticed, which, as was seen at the operation, was an arteriovenous aneurism. The operation of double ligation of both artery and vein in the popliteal space, under antiseptic precautions, was followed by recovery in four weeks. This case stands as an exception, and is not at all comparable to cases of acute diffuse traumatic aneurisms from in-

* Virchow-Hirsch Jahresbericht, 1876, vol. ii, p. 338.

† *Ibid.*, 1880, vol. ii, p. 307.

‡ Guy's Hospital Reports, 1860, vol. vi, p. 334.

§ *Ibid.*, 1861, vol. vii, p. 533.

|| Lancet, April 24, 1875.

juries for which, as far as we know, amputation is still the only safe method of treatment.

It has been advised in such cases to try to save the limb by ligation of the femoral artery. Rabe[*] reports 11 cases, with only 2 deaths, 9 recoveries, no gangrene, and no secondary amputation.

The value of these favorable results of the ligation of the femoral for rupture of the popliteal artery is seriously impaired by the reports from the Franco-German war, in which two cases of gunshot wound of the popliteal artery are on record—one reported by Fischer[†] and one by MacCormac[‡] in which ligation of the femoral artery did not stop the hemorrhage from the popliteal artery. A similar case is reported by Caspary[§] of traumatic aneurism in the popliteal space twenty-seven days after a gunshot wound The femoral artery was ligated. Three days later secondary hemorrhage set in from the popliteal wound, necessitating amputation.

The absurdity of attempting to compare the ligation of the popliteal artery in cases of spontaneous aneurism with the same treatment in cases of traumatic aneurism is shown by one of Rabe's statistical tables, in which 10 cases of Antyllus' operation, namely, double ligation of the artery *in loco* and extirpation of the sac, are reported, with 6 recoveries and the appearance of gangrene in the other 4 cases.

There is one point in regard to the ligation of the large vessels of which very little notice has as yet been taken, but which may in the future be adopted as a means of avoiding the gangrene subsequent to ligation. An extended series of experiments on rabbits, published by Meyer,[||] shows the remarkable fact that the simultaneous ligation of the large vein and artery in the same place was never followed by gangrene nor by any other grave symptoms, such as inflammation or secondary hemorrhage. The case of Annandale, mentioned above, is in conformity with these facts. More extended experiments on the large animals are, however, desirable for the elucidation of this important question.

CASE II.—*Spontaneous Popliteal Aneurism.* (Fenger, Chicago, 1880.)—*Synopsis.—Spontaneous left popliteal aneurism; ligation of left femoral artery in middle of thigh; apparent recovery. Two months and a half later rapidly increasing, fluctuating, non-pulsating tumor in popliteal space; aspiration of thin, viscid blood; no effect. Two weeks later radical operation, accompanied by uncontrollable venous hemorrhage; double ligation of popliteal vein; complete recovery in two months.*

John Smith, a Scotch bricklayer, fifty years of age, noticed in March, 1880, a tumor in the left popliteal space, commencing in a small subcutaneous lump which was movable. This gradually increased in size until it was as large as a hen's egg, and caused him so much pain that he was unable to walk. After he had been in this condition for about six weeks he was seen by Drs. Lee and Fenger, who found, on examination, an aneurism in the left popliteal space of about the size of a hen's egg, with marked pulsation and bruit. Dr. Lee tied the left femoral artery in the middle of the thigh, and the patient was sent to Cook County Hospital for after-treatment. The pulsation and bruit ceased; the wound healed by first intention, and an elastic bandage was kept on the left knee. The patient gradually became able to walk without pain, and was discharged from the hospital June 5th.

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[*] Deut. Zeit. f. Chir., 1875, vol. v, p. 154.

[†] *Ibid.*, 1872, vol. i, p. 264.

[‡] Virchow-Hirsch Jahresbericht, 1872, vol. ii.

[§] *Ibid.*, 1870, vol. ii, p. 348.

[||] Bayersches Aerztliches Intelligenz-Blatt, January 24, 1868.

Shortly afterward he went to work, the swelling in the popliteal space returned, accompanied by pain in walking, and he consequently reëntered the hospital June 16th and was placed under the care of Dr. Fenger.

On examination a small fluctuating tumor was found at the upper margin of the left popliteal space. There were no bruit and no pulsation. The skin covering the apex of the tumor was brownish in color and thin, so that a perforation might be expected at this point. By the use of an exploring needle a little thick, slimy, dark-red fluid was evacuated, which, on microscopic examination was found to contain numerous red blood-corpuscles, but no pus-cells. An elastic bandage was applied, the leg placed in an elevated position, and absolute rest in bed ordered.

June 29th: The tumor has not diminished in size.

July 6th: The tumor is considerably enlarged and very painful.

July 8th: The tumor was aspirated and about six ounces of dark-red, bloody serum withdrawn, and the elastic bandage reapplied.

July 11th: The cavity of the tumor has filled again.

July 20th: The tumor is considerably enlarged, occupying the whole of the popliteal space, to an extent of about seven inches in length and extending on either side beyond the hamstring tendons. Fluctuation can be felt both external and internal to these tendons, these lesser cavities communicating with the main cavity. As the tumor was steadily enlarging and dissecting through the loose connective tissue between the muscles and tendons of the popliteal space, and at the same time threatening to break through the skin, Dr. Fenger resolved upon the radical operation as the only resort for recovery, the patient having positively refused amputation.

July 22d: The patient was anesthetized with ether. A longitudinal incision 10 inches in length was made in the median line of the popliteal space, through the skin and the wall of the cavity; a quantity of the above-described dark-red, viscid bloody fluid was evacuated, and it was then seen that the walls of the cavity consisted of the structures constituting the popliteal space—arteries, veins, muscles, and tendons. These were all covered with a layer of gelatinous, soft and friable substance, 1 to 3 mm. in thickness. This membrane was removed from the main and lesser cavities with the sharp spoon, and a considerable hemorrhage followed. The blood was venous, and poured out rapidly from even the smallest openings, which it was impossible to take up and ligate. Irrigation with a warm 5 per cent. solution of carbolic acid had no influence over the hemorrhage. As the bleeding was most profuse in the middle of the popliteal space, where the blood rushed out through some larger openings, the popliteal vein was isolated and ligated in two places, about three inches apart, whereupon the greater part of the hemorrhage ceased. There was still, however, a considerable oozing of blood from the periphery of the cavity, which was overcome by irrigation with a strong solution of chlorid of zinc. A large drainage-tube was then inserted through the entire length of the cavity, the wound united, and a Lister dressing applied.

July 23d: Very little hemorrhage. The wound was washed out and dressed.

July 24th: No hemorrhage.

July 27th: No hemorrhage. In several places along the edges of the incision wound small pieces of skin have sloughed off and are separating.

August 4th: Drainage-tube removed.

August 11th: The entire cavity is closed and the wound presents a solid, healthy granulating surface.

September 20th: The wound is entirely healed. The dressing was removed, a roller bandage applied, and the patient out of bed and around on crutches.

October 19th: The patient was discharged from the hospital. At this time he could walk on crutches, but was able to bear very little weight on the foot.

March 25, 1881: The patient came to Dr. Fenger's office for examination. He can walk without a cane. The movements of the knee-joint are free, but he cannot exercise the utmost extension on account of the contraction of the cicatricial tissue in the popliteal space. In the popliteal space is seen a large reddish cicatrix, about 5 inches long, and from ¼ to ½ inch in breadth. In the center of this scar is a superficial excoriation about ½ inch in diameter, which causes the patient no pain. There is some edema around the ankles at night after he has been walking about all day long, but it disappears before morning. The foot feels somewhat numb, but otherwise the limb is in its normal condition.

The interesting feature of this case was the constantly enlarging cavity, filled with thin, viscid blood. The exact pathologic nature of this cavity was not shown even by the operation, which occurred two months and a half after the ligation of the femoral artery. It was not a common varix, because the blood was considerably thinner, that is, mixed with serous or synovial fluid; but it was evident that the popliteal vein was involved, as the severe hemorrhage during the operation could not be checked until a double ligation had been passed around the vein.

From an excellent article by Dr. S. W. Gross* we learn that gangrene very seldom follows ligation of the large veins. Secondary hemorrhage or phlebitis is the more common sequel of this operation.

It is more than probable that the secondary hemorrhage is due to the same cause as the phlebitis, namely, suppuration in the wound leading to the ligated vein.

As antiseptic precautions in operations and after-treatment will overcome both of these complications, the surgery of the future should allow us unhesitatingly to perform ligation of the large veins whenever indicated.

Case III.—*Aneurism of the External Iliac.* (Fenger, 1881.)—*Synopsis.—Left inguinal aneurism of three months' standing. Dry gangrene of little toe. Ligation of external iliac. Progress of gangrene. Secondary hemorrhage after thirteen days. Ligation of common iliac. Death five days later.*

E. A. B., aged fifty-five, a speculator on the Board of Trade, came under Dr. Fenger's care July 11, 1881. The patient had never suffered from any serious disease except syphilis, contracted seven years ago. About a year ago, without any perceptible cause, he suffered from neuralgic pains in the toes of the left foot, accompanied by slight swelling, which, with the pain, subsided after a time, but reappeared thereafter at irregular intervals. These symptoms, however, were not so severe as to prevent him from walking around and attending to his business as usual.

About three months ago, April 20th, when pulling on his boots, he was attacked by pain in the region of the left Poupart's ligament, which was so severe as to oblige him to return to bed. After the use of cold applications the pain subsided, and he was again able to walk around. A month later a tumor appeared in the left groin. This gradually increased in size, and commenced to pulsate, and at the same time stiffness and pain along the entire left limb rendered walking impossible.

On June 20th Dr. G. W. Tucker was called in, and found a pulsating tumor in the left inguinal region, covered by Poupart's ligament, extending from ¾ inch above the latter to 2 inches below it. The tumor was oval in form, and about 3 inches in its longest diameter, in the track of the external iliac and femoral arteries, and about 2 inches in its transverse diameter. There was a distinct aneurismal bruit, and pressure on the external iliac above the tumor diminished the size of the latter and caused the cessation of the pulsations.

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* Amer. Jour. Med. Sci., 1867, vol. liii, pp. 17, 305.

July 10th: Dr. Fenger was called in consultation. He found the aneurism as above described; no swelling of the limb, but dry gangrene of the little toe and dark discolorations around the nails of the third and fourth toes. An operation was decided upon and approved by the patient.

July 12th: Dr. Fenger, assisted by Drs. E. W. Lee, S. D. Jacobson, and the House Staff of Cook County Hospital, ligated the external iliac half an inch above the aneurism, and in apparently healthy tissue of the arterial wall. The limb was elevated and hot cans applied.

July 13th: Pulse, 100; temperature, 100° F. The patient did not sleep well last night on account of pain in the limb. There is slight bluish discoloration of the whole foot. No pulsation can be felt in either of the tibial arteries.

July 14th: Pulse, 100; temperature, 100° F. The bluish discoloration has extended around both malleoli and the posterior side of the calf of the leg.

July 17th: Pulse, 90; temperature, 100° F. The discoloration has extended over the lower half of the crus. The patient feels weak.

July 20th: No pus in the dressings. Drainage-tube removed. The wound has apparently healed by first intention. The discoloration is slowly advancing toward the knee, but has no defined limits.

July 25th: This morning it was discovered that some blood had soaked through the dressings, on the removal of which the hole of the drainage opening was found to be filled by a fresh clot. There was no pulsation in the tumor. Ergot and elixir acidum Halleri were administered, and a close watch kept over the patient.

July 26th: Early this morning the hemorrhage recurred, and Dr. Fenger, having the same assistants as in the former operation, ligated the common iliac in the usual manner, ¼ inch above the bifurcation.

July 27th: Pulse, 120; temperature, 101° F. Last night the patient suffered from pain in the left foot, ankle, and groin. He has not vomited, and slept a little during the night. He has taken milk, beef-tea, and brandy. No pain in the abdomen. He feels weak, but talks naturally. The people in the house state that at times he has been a little delirious.

July 28th: Pulse, 130, weak; temperature, 101.5° F. Has had diarrhea all night. The bluish discoloration now extends four inches above the knee. He has a slight cough, and expectorates mucus streaked with blood.

July 29th: The patient grew gradually weaker yesterday afternoon, and died at 9 P. M.

Autopsy twelve hours after death. In the abdominal aorta were found diffused yellowish-white spots of fatty degeneration in the deeper layers of the intima, but no calcareous deposits were to be seen, showing that the endarteritis deformans was in its first stage. The left common iliac was filled by a recent clot from the bifurcation of the aorta down to the ligature. From the bifurcation of the common iliac a firm clot extended an inch down into the internal iliac. The upper part of the external iliac was filled with a firm, but fresh, red clot, which was adherent in some places to the wall. The lower part of the external iliac down to the ligature contained no clot. The catgut ligature had all become absorbed except the knot, which lay loose on the anterior surface of the vessel. Above this was found an irregular perforation 2 mm. in diameter, which leads into the bottom of the wound, through which the secondary hemorrhage took place, and the cavity of which was filled with bloody pus. Excepting at the place of the rupture, where it was thin, the wall of the artery was healthy. Half an inch below the ligature the artery suddenly dilated into an ovate diffuse aneurism, 3 inches long and 2 inches broad. Below the aneurism the wall of the femoral artery showed masses of products of endarteritis deformans, but without calcareous deposits, the diameter of the vessel being about normal. In the profunda femoris, about ½ inch below its origin, the vessel was narrowed, and the thickened wall entirely incrusted with calcareous matter. The popliteal artery was filled with fluid blood, and signs of commencing endarteritis were noticeable only in isolated spots. The femoral vein was open above Poupart's ligament, but at this point commenced an adherent thrombosis which extended down as far as the popliteal vein, caused by compression of the walls of the aneurism.

In this case complete recovery was not to be expected, as the gangrene had already commenced before the first ligation, and the plan of treatment was necessarily limited to—first, the stoppage of pulsation in the aneurism by ligature, and, second, amputation, when the progressing gangrene showed a sufficient time of demarcation to permit us to determine how high up the operation should be made.

During the whole time from the first ligation until the secondary hemorrhage occurred no such demarcation of the slowly progressing gangrene took place, but at the same time no marked constitutional symptoms made a speedy amputation imperative.

It is possible that this was caused by the very careful disinfection and antiseptic dressing of the whole of the gangrenous portion of the limb. But if this be erroneous, the antiseptic dressing had this effect, that at no period, even at the patient's death, were the slightest traces of gangrenous odor perceptible on the removal of the dressings.

The occurrence of the secondary hemorrhage in a part of the external iliac where the wall was healthy confirms the opinion of Rabe that secondary hemorrhage at the point of ligation is due, not so much to a pathologic condition of the intima and media, or to the distance from the point of ligation to the first branch of the artery above it,—that is, to the length of the clot above the ligature,—as to the suppurative destruction of the external coat of the artery, since in this case the ligation wound did not heal by first intention.

The autopsy further shows that the secondary hemorrhage was not due to too early absorption of the catgut ligature, as the perforation in the arterial wall, through which the hemorrhage took place, was situated above the point of ligation.

Case IV.—*Cirsoid Aneurism of the Head.* (Lee, 1879.)—*Synopsis.—Large cirsoid aneurism of the entire frontal region, of eighteen years' standing; rupture of aneurism; ligation of right common carotid with no effect; fifteen days later ligation of left common carotid; aphasia and right-sided hemiplegia; cessation of hemorrhage; three days later extirpation of the entire tumor; extreme anemia; transfusion of ten ounces of blood; complete cessation of hemorrhage; four days later, erysipelas; death five days after the operation.*

W. H. D., ged twenty-six. American. Shingle sawyer. Was admitted to Cook County Hospital July 28, 1879, placed under the care of Dr. Lee, and gave the following history:

When about eight years of age he sustained a contusion in the region of the anterior fontanel by running against the end of a fence-rail. The force of the blow prostrated him, but he did not lose consciousness. After a few hours a tumor of about the size of a hazelnut appeared, which was at first tender to the touch and painful, but later on became painless and remained *in statu quo* for eighteen months. From that time it slowly increased in size, so that when he was fourteen years of age it was as large as a walnut. It then became sore and painful, in three weeks ruptured, bled profusely for a time, and then healed kindly. He underwent a short course of treatment by compression with a rubber ring, but derived only temporary benefit therefrom. From this time the tumor increased in size more rapidly. When the patient was twenty years of age it was as large as a man's hand, and elevated about an inch above its origin, and gradually decreasing toward its margin. A new tumor now began to develop on the forehead, just between the eyebrows. During the succeeding six years the tumor increased in size very slowly, and caused the patient no especial inconvenience. Six weeks previous to his admission to the hospital a small white spot appeared at the apex of the tumor; on July 2, 1879, this was accidentally punctured by the tooth of a comb and bled very profusely. The hemorrhage was not *per saltum*, and was controlled by a compress. During each dressing the hemorrhage recurred with a like severity. The patient was kept in the recumbent posture for three weeks, a firm compress being applied at the bleeding point. The ulcer still continued to increase in size notwithstanding this compress, and on July 28th he applied at the hospital for treatment.

On examination the scalp and underlying tissues were found to be the site of an elastic, racemose tumor, elevated at its apex about 1½ inches from the bone, extending longitudinally from the bridge of the nose to the occipitoparietal suture, and laterally from 1½ inches above one ear to the same distance above the other. The tumor presented an irregular ulcer 3 inches long by 2½ inches in width, which bled on the slightest provocation. It was found to be supplied by the supra-orbital, temporal, and occipital arteries, as the hemorrhage could be controlled by an elastic band applied just above the ears. The diagnosis was cirsoid aneurism, and the following plan of treatment proposed: First, ligation of the right common carotid; second, ligation of the left common carotid; extirpation *en masse* of the vascular growth.

August 2d: The patient was anesthetized and a catgut ligature placed around the right common carotid, just above the omohyoid muscle. Antiseptic dressings were used, and the wound healed by first intention. The hemorrhage from the ulcer was at first greatly diminished, but daily increased as the collateral circulation was established. The patient showed no signs of cerebral disturbance.

August 5th, A. M.: Pulse, 68; temperature, 99.5° F. P. M.: Pulse, 72; temperature, 99° F. The ulcer was dressed. The hemorrhage was so severe that Dr. Lee attempted to control it by compression of the left common carotid. He succeeded, but the patient was immediately thrown into a tonic muscular spasm, lost consciousness, and ceased to breathe. On the removal of the compress and after resorting to artificial respiration the patient recovered consciousness.

August 6th, A. M.: Pulse, 76; temperature, 99.4° F. P. M.: Pulse, 72; temperature, 100° F.

August 7th, A. M.: Pulse, 66; temperature, 100° F. P. M.: Pulse, 78; temperature, 100.4° F. The patient is drowsy, his appetite poor; he complains of severe pain in the tumor; has no paralysis or paresis.

August 10th: Very much improved. He is now as well as before the operation. Pulse and temperature are about normal.

August 17th: Ligated the left common carotid. During the operation the patient ceased to breathe and had a tonic convulsion, but normal respiration was restored after about five minutes' artificial respiration. His extremities became very cold and his pulse feeble. Two hours later the pulse was full, slow, and strong. He opens his eyes when he is spoken to, but does not attempt to speak. He cannot swallow; does not attempt to move his right extremities, and lies all the time in a semisomnolent condition.

August 18th, A. M.: Pulse, 94; temperature, 99.2° F. Patient has paresis of right half of body. He can swallow liquid food and is much brighter than last night. P. M.: Pulse, 92; temperature, 100.1° F.

August 19th, A. M.: Pulse, 100; temperature, 99° F. The aphasia continues; deglutition is not improved; the paresis of the arm and leg is decreasing. During the dressing of the ulcer there was no hemorrhage, showing that the supply was cut off. P. M.: Pulse, 106; temperature, 100.6° F.

August 20th, A. M.: Pulse, 88; temperature, 98.8° F. Paresis improved, and primary union of the last operation wound obtained. The patient was anesthetized, and Dr. Lee, assisted by Dr. Fenger and the house staff of the hospital, now proceeded to the third part of the proposed treatment—the extirpation of the tumor. He made first a crucial incision, dissected off the scalp from the tumor, and removed it from the bone. In many places it included the periosteum. There was not much hemorrhage, but the shock was severe. The pulse became very rapid and feeble before the completion of the operation. Heat and stimulants were freely used, and the patient rallied. Two hours after the operation the pulse was 138; temperature, 99° F., and the patient had not fully recovered consciousness,

August 21st, A. M.: Pulse, 118; temperature, 98.8° F. P. M.: Pulse, 156; temperature, 101.8° F. The patient is failing fast—is very drowsy. The pulse is very feeble, notwithstanding the use of the most powerful stimulants. Transfusion was performed, and ten ounces of blood injected into the basilic vein. At first the patient's pulse increased to 190, but fell slowly as the blood became diffused through the body. In two hours the pulse had fallen to 120, and was full and strong, but soon commenced to increase, and at 11 P. M. was 145.

August 22d, A. M.: Pulse, 120; temperature, 99.2° F. The patient's intellect is brighter, and deglutition less difficult. Stimulants are given in large and frequently repeated doses. P. M.: Pulse, 140; temperature, 101.5° F.

August 23d: Pulse, A. M., 120; P. M., 138. The patient vomited without nausea. He takes stimulants. Pulse very feeble.

August 24th, A. M.: Pulse, 112. Patient is feeling fairly well. The wound was dressed; no suppuration. A small erysipelatous blush and a few bullæ appeared around a small ulcer on the side of the face. This was painted with nitrate of silver. Quinin and alcoholic stimulants were given in large doses. 11 P. M.: Pulse, 140; temperature, 103° F. 12, MIDNIGHT: Pulse, 150; temperature, 104° F.

August 25th, 1 A. M.: Pulse, 146; temperature, 104.5° F. 2 A. M.: Pulse, 150; temperature, 105.5° F.; respiration, 14. 3 A. M.: Pulse, 165; temperature, 106.5° F.; respiration, 20. 4 A. M.: Pulse, 180; temperature, 106.3° F.; respiration, 20. Patient is in a comatose condition, breathing very labored. The pulse and temperature were taken every hour, but they remained about the same until 11 A. M., when the temperature had fallen one degree, but the pulse had not changed, and the patient continued comatose. 2 P. M.: Pulse, 150; temperature, 105.8° F. 7 P. M.: Pulse, 170; temperature, 104.5° F. Soon after this the patient died. No autopsy was made.

As no autopsy was made in this case, the cause of death is necessarily doubtful. The possible causes of death were three: First, exhaustion; second, malnutrition of some portion of the left side of the brain, and third, septicemia.

The notable rise in temperature in the last two days before death is a strong point in favor of septicemia and against the other two causes named. It is a well-known fact that septicemia is more likely to occur, *cæteris paribus*, in exhausted or anemic than in robust subjects. But, on the other hand, every surgeon who has a sincere belief in antiseptic surgery will consider the occurrence of septicemia due rather to his failure to attend to all the details of antisepsis than to any bodily predisposition of the patient.

There can be no doubt as to the efficacy of the operation of extirpation of the vascular growth, preceded by ligation of the main trunks of the supplying vessels, as, in spite of the fatal result, no secondary hemorrhage occurred. The total extirpation is the only effective method, when practicable, without immediate danger to the patient's life from hemorrhage, as in 10 cases reported in the literature treated by this method, cure was effected in all.*

All other methods of treatment—ligation of the vessels, injection of styptic fluids, acupuncture, ligation of the tumor, and the galvanocautery—have been found, to say the least, unreliable; ligation of one or of both common carotids may be justifiably resorted to as a preparatory measure only, to avoid fatal hemorrhage during the operation in case of very extensive tumors. If possible, the ligation of the second carotid should be avoided, on account of the danger from brain symptoms, due to local anemia or even malnutrition of important parts of the brain.

From the history it is easily seen that the case was an unusually desperate one, on account of the rupture which precipitated surgical interference to a dangerous extent, necessitating the ligation of the second common carotid too short a time after the first ligation. But still the interval of fifteen days is within the limits of similar cases followed by recovery without brain symptoms. We should feel inclined, however, in a similar case to pass a loop around the second common carotid as a precautionary measure during the extirpation.

CASE V.—*Traumatic Aneurism of Internal Carotid Artery.* (Lee, 1879.)—*Synopsis.—Bullet wound of left infra-orbital region. No hemorrhage. Subsequent swelling in parotid region. Fifteen days later, wound healed. Swelling of hard and soft palate. Incision of the latter, followed by uncontrollable arterial hemorrhage and death in a few minutes.*

J. C., aged twenty-eight, Irish laborer. On the night of September 30, 1879, during a riot, a crowd of men, of which he was a member, surrounded a railroad car. The patient was standing close to the car, facing toward it and looking upward, when a pistol was fired in his face from the window of the coach, the ball striking him to the right of the nose, a little below the eye. On the following morning Dr. Lee was called to see him. On examination it was found that the bullet had entered at the outer edge of the nasal process of the right superior maxillary bone, immediately below the margin of the orbit. There was much ecchymosis and inflammation, and the margins of the wound were closely coaptated. The pulse was 120; temperature, 101° F. He was suffering slightly from shock, was very restless, and complained of pain in his jaws, which were firmly closed, and any attempt to open them caused him severe pain; deglutition was painful. No exploratory incision was made to ascertain the whereabouts of the ball. Hot fomentations and anodynes to allay the pain were ordered.

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* Heineke: Pitha and Billroth's Handbuch der allgemeine und speciellen Chirurgie.

Dr. Lee visited the patient daily for a week. At the end of this time the swelling in the face had entirely subsided, but slight tumefaction of the right side of the neck remained, and the pulse and temperature had fallen nearly to the normal point. When he made his daily visit on the eighth day he found that the patient had gone down to the city to look after some business matters. During the following week Dr. Lee did not see the patient, but on the fifteenth day after the injury he called at the doctor's office and complained of inability to speak or swallow, and also of a severe pain in the right side of the neck, which, he said, he could not bend. His appearance was that of a man suffering from severe tonsillitis. With considerable difficulty Dr. Lee succeeded in opening the patient's mouth enough to permit of limited inspection. The tonsils and soft palate were so swollen as to preclude inspection of the pharynx. On the hard palate there was a small, firm tumor, about the size of a hickory-nut. Thinking this might be the ball surrounded by inflammatory products, he made an exploratory incision with a gum lancet, and a few clots of blood escaped. He then attempted to introduce his finger to explore the cavity, but found it necessary to enlarge the opening. He then removed some more clotted blood. This was immediately followed by a gush of bright arterial blood, accompanied by a peculiar hissing noise. From the volume and force of this current the immediate inference was that its source of supply was from some large vessel. He attempted to stanch the flow of blood by compression with a napkin, in which endeavor he was momentarily successful, expecting thereby to gain sufficient time to ligate the common carotid. At this critical moment Dr. Lee's only assistant, a friend of the patient who had accompanied him to the office, became panic-stricken and fled; the patient became very much excited and struggled so violently that Dr. Lee was unable to retain the compress in position, the hemorrhage recurred, and in a few moments the patient died.

Autopsy Made by Dr. Fenger.—Rigor mortis. Mouth and nostrils filled with coagulated blood. Half an inch below the margin of the right orbit was found a small, recent, perfectly closed cicatrix surrounded by normal skin. Right parotid region as well as the region around the angle of the jaw to about an inch below the latter swollen, but covered with normal skin.

An incision was made along the anterior border of the sternocleidomastoid muscle, and was carried down to the common carotid, which was found to be normal. In dissecting up from the latter, in order to expose the external and internal carotid, about a teaspoonful of pus was found in the tissues covering the bifurcation, at a point corresponding to the lowest part of the above-named swelling. In dissecting upward internal to the stylohyoid and styloglossus muscles a cavity was found, which contained some old and some recent clots, after the removal of which the finger could be introduced into an irregular cavity, about an inch and a half in diameter. The external wall of this cavity was formed by the above-named muscles; the posterior wall, by the anterior surface of the first two or three cervical vertebræ and the basilar portion of the occipital bone, and the anterior wall, by the posterior wall of the pharynx. Here the hamular process of the internal pterygoid plate of the sphenoid bone could be felt distinctly. The finger, when passed around this, penetrated into a small cavity between the soft and hard palates. A probe passed through the mouth and the small incision in the mucous membrane covering the posterior part of the hard palate would enter this last-named cavity.

Further dissection of the internal carotid revealed the following (as the members of the society will see from the specimen herewith exhibited): In the internal carotid, about an inch above the bifurcation, was a circular opening two lines and a half in diameter. Below this opening the vessel was normal; above, it was contracted to about half its normal diameter. A probe introduced into the opening in the artery passed through a second opening in the posterior internal wall, immediately behind which, in the adventitia of the artery, was found the bullet. It was a 32-caliber bullet, with rough, irregular external surface from having passed through bone, and was, as will be seen by the specimen, firmly lodged in and adherent to the above-named connective tissue of the adventitia.

The cases in which traumatic aneurism of the internal carotid is caused by an injury the nature of which does not occasion any suspicion of a wound of this vessel are exceedingly rare, and also, as a natural consequence, so difficult to diagnosticate that in all probability they have all terminated in an unexpected death, the diagnosis having been cleared up only by the autopsy.

The places where the tumor or swelling due to a traumatic aneurism of the internal carotid can be seen are the parotid region, the region of the tonsil, and the palate. A swelling in these regions may easily be mistaken for a parotitis, a tonsillitis, or, as in the above-described case, the seat of the bullet.

Without any further comments we shall now call attention to a parallel case cited by Fisher.* A man, thirty-three years old, was smoking a long pipe. He went down suddenly, and the pipe broke. This was followed by a slight bleeding from the mouth which soon ceased. The end of the stem of the pipe could not be found. Five days later a swelling of the right parotid region, tonsil, and palate commenced. This swelling remained stationary for eight months, after which time it increased in size. One day, while hunting, a severe hemorrhage from the mouth occurred, followed six hours later by fatal hemorrhage.

The autopsy revealed a ruptured opening in the right palate, through which a probe passed into a cavity filled with blood and pus, surrounding the internal carotid, by the side of which the lost pipe-stem was found.

It is an interesting and perhaps not altogether accidental coincidence that in both of these cases of traumatic aneurism of the internal carotid the point through which the fatal hemorrhage took place should be the same—an anatomic fact that might be taken as a hint for possible diagnosis in future cases.

CASE VI.—*Traumatic Aneurism of the Upper Part of the Vertebral Artery.* (Fenger, 1881.)—*Synopsis.—Revolver bullet wound in upper part of back of neck. Transient arterial hemorrhage. Four days later pulsating tumor in left infra-auricular region. Ligation of left common carotid. Cessation of pulsation. Twenty days later, wound healed. Return of pulsation and pain. Eight days later, radical operation for the aneurism, with ligation of left vertebral artery, between the occiput and axis. Extreme anemia. Transfusion of eight ounces of blood. Five weeks later wound healed. Patient out of bed. Perfect recovery.*

George Covey, nineteen years of age, a cook by occupation, was brought to Cook County Hospital on the night of January 6, 1881. During the evening he had been drinking heavily, and when intoxicated became involved in a quarrel and received a bullet wound in the back of the neck from a 32-caliber revolver. The wound was immediately followed by a very considerable hemorrhage. The patient stated that a stream six feet high and as large as his little finger spurted out of the wound, and that one of his companions put his finger over the wound to stop the bleeding until a physician could be called in. The bleeding then stopped, but in the course of fifteen minutes so considerable a swelling set in around the left angle of the lower jaw and in the parotid region that he was not able to separate the jaws more than half an inch. The physician probed unsuccessfully for the ball, then dressed the wound, and directed that the patient be sent to the hospital.

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* Billroth and Luecke's Deutsche Chirurgie.

On examination the patient was found to be robust and well nourished; 5 feet 9 inches tall; 183 pounds in weight; no hereditary predisposition. He has always enjoyed good health. On the upper part of the posterior side of the neck is the entrance opening of the bullet wound, situated about an inch external to and to the left of the posterior median line of the neck, on a line with and 2¼ inches behind the mastoid process. There is considerable swelling in the left parotid region, extending forward upon the masseter and around the left eye, where the tissues are infiltrated with blood, as is seen from the bluish color of the covering skin. He can open the mouth only about ½ inch. In the left half of the floor of the mouth, at the side of the tongue, is a swelling, bluish red in color from submucous extravasation of blood. There is constant severe pain in the region of the swelling, especially around and behind the left angle of the lower jaw. The wound was carefully probed, but the bullet was not found. The wound was then dressed antiseptically, and morphin administered for the alleviation of the pain. The pulse and temperature were normal.

January 11th: Last evening, when the patient was straining at stool, he experienced suddenly a sensation as if something had given way—he thought it was the bullet—behind the angle of the jaw. This was immediately followed by excessive pain below the left ear, which made him cry out in agony. He went to bed, and, notwithstanding the administration of considerable quantities of morphin, violent pain continued in the region of the left temporomaxillary articulation and below the left ear. The pain was accompanied by a sensation of pulsation which moved his lower jaw and teeth, or, as he expressed it, "kept the teeth throbbing up and down" synchronously with the pulse.

January 15th: The pain is increasing so that it keeps him in constant agony. In the left subauricular region is a pulsating tumor the pulsations of which are easily felt through the upper part of the sternocleidomastoid muscle. On the application of the stethoscope here a distinct aneurismal bruit is heard. As there could be no doubt of the presence of a traumatic aneurism at this point, Dr. E. W. Lee, assisted by the house staff of the hospital, ligated the left common carotid artery.

January 16th: Pulse, 100; temperature, 99° F. The patient slept well and feels well.

January 17th: Pulse, 116; temperature, 101.8° F.; doing well.

January 20th: Pulse, 92; temperature, 103° F. Wound dressed; very little pus on the dressings. Feels well.

January 28th: The bullet wound is entirely, and the operation wound almost, closed. The patient walks about all day, sleeps and eats well, and feels well, with the exception of a slight headache. He states that he feels a slight sensation of pulsation below the left mastoid process, but no pulsation can be detected, and the stethoscope reveals no bruit.

February 1st: This morning the patient went to court to have his case tried. While this was in progress he was obliged to stand up for an hour or two answering questions. He became very tired, the sensation of pulsation became more and more intense, the severe pain recurred, and he felt weak. On his return to the hospital a slight pulsation could be felt behind and below the left mastoid process, but the stethoscope could detect no bruit.

February 3d: The patient is confined to his bed, and complains of headache and increasing pain in the region of the pulsation. Potassium iodid and ergot are administered.

February 7th: The pulsations and pain are increasing. He can sleep only by the aid of morphin. With the stethoscope no distinct aneurismal bruit is heard, but the propagated heart-sounds are heard as distinctly as if the stethoscope had been applied over the common carotid.

February 9th: As there was no doubt that a traumatic aneurism had recurred, and by bursting into one of the adjoining cavities was endangering the life of the patient, Dr. Fenger resolved to make the radical operation as a last resort to save the life of the patient. The patient was anesthetized with ether, and Dr. Fenger proceeded to operate, assisted by Drs. E. W. Lee, J. B. Murphy, and the internes of the hospital, Dr. W. P. Verity, House Surgeon, and Drs. Bradley, Meacher, Macarthur, and Kendall, and in the presence of Mrs. Dr. Sprague, of Pennsylvania, Dr. Steele, of Oshkosh, Wisconsin, Mr. Stanton, and others.

As the ligation of the left common carotid had caused stoppage of the pulsations, Dr. Fenger resolved to commence the operation by securing the external carotid. An incision three inches in length was made along the entire upper half of the sternocleidomastoid, the tissues carefully separated, a careful watch kept for the pulsating vessels around the border of the pulsating tumor, with a view to securing them by ligature, either isolated or en masse, before opening the sac of the aneurism. When on pressure in various places pulsation was apparently felt and the aneurismal pulsation seemed to cease, an aneurism needle, armed with heavy aseptic silk, was passed successively around the area of the tissue involved, and ligature en masse tied, but always in vain. After four or five such ligatures had been passed the pulsation in the aneurism remained the same as before. Dr. Fenger now determined to lay open the sac and catch up the supplying artery *in loco.* To this end a transverse incision, 2½ inches in length, was made, extending from the upper end of the former incision backward from the mastoid process, through the skin and insertion of the sternocleidomastoid, in order to secure the posterior occipital artery, which might possibly be the vessel supplying the aneurism. After the sternocleidomastoid had been removed, the pulsation could be felt very distinctly.

After cutting through the thin layer of the deep muscles of the neck the aneurismal cavity was opened, which was partially filled with dark clots of blood. After the removal of these clots a large quantity of arterial blood spurted out. The hemorrhage could be controlled only by pressure on the bottom of the cavity at its deepest part. On the introduction of a finger at this point the inferior portion of the squama ossis occipitis, denuded to the extent of about ½ square inch, could be felt. At the internal wall formed by the atlas and axis some irregular splinters of bone could be felt. While one of the assistants kept a finger pressed against the bottom of the cavity to control the hemorrhage, the tissues were cut through downward along the transverse processes of three or four cervical vertebræ, and the whole of the sac laid open, which necessitated the removal of the upper fourth of the sternocleidomastoid muscle. On the suggestion of Dr. Lee the right common carotid was cut down upon, an aneurism needle passed around it, and the vessel compressed to see if it would have any effect upon the hemorrhage, but it had not. As soon as the finger was removed the blood gushed out as before, and the only effect of the pressure was to cause cessation of the patient's breathing. Artificial respiration had to be carried on for about five minutes, during which time hypodermic injections of whisky were made, whereupon respiration again commenced.

Search was now made for the vertebral artery, which finally was taken up at its curvature around the atlas and secured by a ligature. The bleeding then stopped. The vertebral artery was unusual in size, being nearly as large as the internal carotid.

During the ligation of the vessel respiration stopped again, no pulse could be felt, and the patient seemed dead. Artificial respiration, hypodermic injections of whisky, and rubbing of the cold extremities restored the respiration and the almost extinct life. The wound was speedily united, drainage-tubes inserted, Lister dressing applied, and the patient brought to bed. He was cold and almost pulseless. The radial pulse was 170 and scarcely perceptible. The crural artery was pulsating with little more vigor than the normal radial. Dr. Fenger thereupon immediately proceeded to transfuse slowly eight ounces of defibrinated blood. This was accomplished by means of a cannula with rubber tube and common syringe. At the end of the transfusion the radial pulse gained remarkably in strength and decreased to 150. Hot bottles and warm blankets were now applied, and another hypodermic injection of whisky given.

February 10th, A. M.: Pulse, 140; temperature, 99.3° F. Has rallied from the shock so that he can speak clearly. He says that he feels weak, but has no pain and is warm. As he is not able to move his head, wine and a considerable quantity of milk have been administered through a tube.

February 15th: Pulse, 108; temperature, 98.4° F. The patient is getting a little stronger. He is still unable to move his head, but rests well nights, takes considerable food, and has no pain nor sensation of pulsation. The wound was dressed. Very little discharge was found on the dressings.

February 17th: Drainage-tubes removed; very little discharge. The patient suffers pain only when his head is moved.

March 15th: The wounds are healed. The patient is able to sit up and to walk about the room. He can now move his head freely to the right side, but cannot move the chin to the left beyond the median line. He can open his mouth, but is unable to masticate on the left side. There is no pain, swelling, or pulsation in the region of the former aneurism, but there is a little hard tumor and slight tenderness on pressure in the region a little anterior to the temporomaxillary articulation.

March 25th: Is up and about the whole day long. No pain or pulsation. Some stiffness of the neck when he attempts to turn his head to the left.

April 7th: Left hospital.

June 20th: He feels perfectly well with the exception of slight stiffness of the neck.

August 8th: He came to Dr. Fenger's office and stated that he had been working as a cook on a lake steamer. The stiffness of the neck had disappeared, and he could move his head freely in all directions. There was some flattening in the region of the upper part of the sternocleidomastoid muscle, but no pain on pressure. Movements of the jaw were free and painless.

This case is of more than ordinary interest, because it is the first case on record in which ligation of the vertebral artery has been performed successfully between the occiput and axis, and, further, because it is the fifth case of 34 on record in which a wound including traumatic aneurism of the vertebral artery has terminated in recovery.

The diagnosis of a vertebral aneurism is, in the majority of cases, obscure, that is, it is often very difficult to decide whether the pulsating swelling in the lateral region of the neck is due to an injury of the vertebral artery, on the one hand, or the common carotid or one of its branches, on the other. This well-known fact is well illustrated by the symptoms in our case. The swelling set in simultaneously in the parotid region and posterior region of the mouth; in the case of aneurism of the internal carotid, reported above, the swelling occurred in exactly the same place, which is characteristic of aneurism of the latter artery. It was, therefore, natural for Dr. Lee to make the ligation of the common carotid. This case was the more deceiving as the ligation was followed by relief of the pain, decrease of the swelling, and cessation of the bruit. The continuance of the subjective sensation of pulsation felt by the patient would naturally lead rather to the conclusion that this distant or Hunterian ligature had been unsuccessful on account of the establishment of collateral circulation in some of the branches of the carotid system, than to the conclusion that the location of the aneurism was outside of this, that is, in the vertebral artery.

Even after the second return of pulsation and bruit, when Dr. Fenger resolved upon the radical operation, he expected rather to have a branch from the carotid system to deal with than the vertebral artery.

The only means of determining whether an aneurism in this region is supplied by the carotid system or the vertebral artery is, as is well known, alternate, isolated compression of the vertebral and common carotid arteries. The vertebral artery may be compressed against the cervical vertebræ below the carotid tubercle, but in this place pressure is likely to occlude both the common carotid and the vertebral arteries. Above the carotid tubercle, that is, above the place where the vertebral artery enters the canal, it is possible, by pressure, to occlude the common carotid alone. In the majority of cases this will be conclusive, but it is not always reliable, as the vertebral artery may enter the canal at the fourth or fifth instead of the sixth cervical vertebra. Consequently it is not only always difficult, but it may, in certain cases, be impossible exactly to locate the vessel supplying the aneurism.

If, however, this difficulty has been overcome, that is, if the vertebral artery has been found to be the vessel supplying the aneurism, what is to be done?

A priori, we have the choice of three methods of procedure: First, external compression: second, ligation of the vertebral artery below the carotid tubercle; third, the radical operation, that is, the opening of the sac, removal of the clots, and stoppage of the hemorrhage by ligation or compression. It is almost needless to state that the two first methods are unreliable, but still direct pressure succeeded in stopping the pulsation, with recovery of the patient, in Mobe's case, reported by Kocher.* The majority of patients cannot endure a pressure sufficient to cure the aneurism on account of the excessive pain; but this procedure should, of course, be tried before resorting to more radical measures, as cases may be found in which either the wound in the artery is so small, or the local conditions otherwise so favorable, that absolute immobility of the parts may cure the aneurism. This has been seen in a case cited by Holmes† in which spontaneous cure, "aided only by applications of cold," took place.

The ligation of the central end of the vertebral artery below the carotid tubercle has not been resorted to in any of the successful cases on record, although the artery has been successfully tied at this place for other purposes.

The radical operation has, finally, to be resorted to when pressure fails to cure the aneurism. In the course of the artery through the canal in the transverse processes of the cervical vertebræ, it has hitherto been and will probably always be impossible to apply a ligature to the artery, and consequently the only means by which the hemorrhage in the exposed cavity of the traumatic aneurism can be checked is by plugging the cavity with tampons so as to occlude the opening in the artery. This treatment was successful in Kocher's case (*op. cit.*), in which pulsation and hemorrhage occurred after a punctured wound in the region of the fifth and sixth cervical vertebræ. When he had laid open the cavity, he could see both ends of the divided vertebral artery, but was unable to seize and ligate them. The cavity was plugged with tampons soaked in perchlorid of iron, and, notwithstanding an attack of erysipelas during the after-treatment, the patient recovered.

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* Langenbeck's Arch. f. klin. Chir., vol. xii; Virchow-Hirsch Jahresbericht, 1871, vol. ii, p. 331.

† System of Surgery, vol. ii, p. 415.

The same method was resorted to by Dr. J. Mason Warren,* to the courtesy of whose son, Dr. J. Collins Warren, of Boston, Mass., we are indebted for the report of the case. A boy eleven years of age received a gunshot wound of the vertebral artery, followed by violent hemorrhage. On the following morning Dr. Warren resected a portion of the transverse process of the second or third cervical vertebra. The hemorrhage now recurred. Systematic plugging with bits of sponge was now resorted to, and was followed by the recovery of the patient.

In the upper part of the artery, between the occiput and axis, the ligation can be done, as was shown in our case, and is, it is needless to state, preferable, as it is as safe a method as plugging is unsafe. That the ligation at this point is difficult will be seen by the remark of Vischer † that "the part of the artery between the occiput and the transverse processes of the first and second cervical vertebræ is not accessible for direct ligation, even when a part of the sternocleidomastoid muscle has been removed."

As will be seen from the history of the case, our patient came very near dying on the table, and lost so much blood that immediate transfusion was imperative. It is, however, possible that the ligation at this point in a similar case might be facilitated by, as a preliminary step to, the operation, cutting down upon and securing the central end of the vertebral artery below the carotid tubercle by a loop, to be used for compression during the operation. We shall not hesitate to recommend and employ this procedure in similar cases in the future.

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* Surgical Observations, with Cases and Operations, by J. Mason Warren, M.D., Boston, Mass., 1867.

† Billroth and Lücke's Deutsche Chirurgie.

THE THORACOPLASTIC OPERATION OF ESTLANDER *

In the last twenty years the treatment of empyema has gradually drifted from the repeated aspirations through the stage of the use of the permanent cannula into the stage of free incision, with excision of a piece of a rib, if necessary, and with thorough drainage, with or without the washing-out of the cavity.

The repeated aspiration will possibly retain a permanent place in the treatment of empyemas in children: the permanent cannula will never attain its object, namely, to shut out air from the pleural cavity, except when evacuation and washing out are performed. It will, consequently, have to be abandoned in favor of the more effective method of free incision. But it was natural that the two first-named methods should have their trial before the advent of antiseptic surgery, which has enabled us so to disinfect the air entering the pleural cavity through the drainage-tube at each inspiration as to render this air free from noxious germs, and, consequently, harmless.

The antiseptic method, then, is a *conditio sine qua non* for the employment of the method of free incision; it also enables us to treat the cavity on rational modern surgical principles; that is, to have two openings,—an anterior and a posterior,—and sufficient drainage through these to effect not only the evacuation, but also the thorough washing out, and, if necessary, the disinfection, of the cavity.

Homén, in his interesting paper on Estlander's method,† has been able to gather statistics of 52 cases of empyema treated by free incision, with all antiseptic precautions. Of these, 50 per cent. recovered, 33 per cent. died, and in 17 per cent. permanent fistulas remained.

Homén's total statistics include 141 cases treated by free incision, but in all of which strict antiseptic precautions had not been observed. As may be expected, the results of the operation are less favorable than in the class of cases just mentioned. Of these, 46 per cent. recovered, 33 per cent. died, and a permanent fistula remained in 21 per cent.

As our attention is to be called only to the treatment of permanent pleural fistulas, we will now look a little closer into the condition of patients so affected, and then into the prospects for their future.

The fistulous opening leads, with the exception of a few cases, in which the sole remnant of the empyema is a carious rib, into a cavity between the thorax and the lung—a cavity with fibrous connective-tissue walls, covered with a layer of soft, pus-secreting granulating tissue, and usually without, but sometimes with, connection with one of the bronchi. It is needless to state that the size of such a cavity, and the amount of purulent matter secreted from its walls, may vary indefinitely; but even a small cavity, with a moderate secretion, is not only a constant inconvenience to the patient, but also a fruitful source of danger to his health and life in the course of time.

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* Med. News, 1882, vol. xli, p. 337.

† Langenbeck's Arch. f. klin. Chir., 1881, vol. xxvi, p. 151.

The patient usually is pale, weak, and unable to perform the ordinary duties of life. From time to time the fistula may close up, and retention of pus, with subsequent pain, exhaustion, and fever, result. In cases where primary tuberculosis or cheesy deposits in the lung tissue do not exist or are at a standstill, the constant suppuration of the cavity, together with the formation of a deposit of cheesy matter, may be the starting-point for tuberculosis, or, by breaking down the patient's general health, may arouse a latent tuberculosis.

But if tuberculosis be not the main danger in these cases, there is another, just as serious, and perhaps more certain sooner or later to ensue, namely, the amyloid degeneration of the kidney, spleen, and liver. In the majority of fistulas we are liable to find some day, sooner or later, the patient with edema around the malleoli, a slight amount of albumin in the urine—sure signs that he is approaching the inevitable fatal termination.

The objection might be made here that a number of cases are met with and on record in which, for a long series of years, a discharging thoracic cavity has been sustained without much impairment of the general health, without the development of tuberculosis or amyloid degeneration. But this being granted, we must confess that in such cases we never know when the fatal complications will commence—whether in a few months or in a few or many years. Consequently we must regard every permanent empyema cavity as a constant menace to the life of the patient.

In view of these considerations it is not only our prerogative, but also our duty, to try every reasonable means for the obliteration of the cavity.

It is not my intention here to discuss the whole local and general treatment of empyemas, the various fluids injected, and so on. This paper is intended to treat only of those empyema cavities where the rational operation has been performed in time, where antiseptic dressing, accompanied by thorough drainage and washing out with the various disinfectant and alterative fluids, has been used; in short, where all other possible means have been exhausted, but the lung will not expand any more, the thorax cannot sink in any more, and no injection of fluid causes any formation of connective tissue to fill up the cavity; it is in these cases that we are obliged to employ Estlander's operation.

The only way to close an empyema cavity in this condition is to effect, by an operation, a more or less complete contact of the walls of the cavity. As it is not in our power to act upon the internal or pulmonary wall of the cavity, or, in other words, as we are unable to bring the surfaces of the lung out in contact with the wall of the thorax, nothing is left but to obviate the rigidity of the wall of the thorax by taking away, from the ribs covering the cavity, pieces as large and as many as may be necessary to effect a further sinking in of the thoracic wall, and sufficiently extensive to bring the latter in contact with the surface of the lung.

Before discussing the details of the indications for the operation, the operation itself, and the after-treatment, I will report the following case as an illustration:

Right-sided pleurisy, resulting in empyema; repeated aspiration; inefficient fistulous opening discharging for a year and a half; dilatation of opening, drainage, and washing out; no counteropening; daily washing out for a year; removal of 7 cm. of the sixth, 6 cm. of the fifth, and 6 cm. of the fourth rib in the axillary region over a transverse cavity 2 inches long, 1½ inches high, and about 1 inch deep; slight fever for six days; small subcutaneous abscess below the scar after eighteen days; drainage-tube of cavity removed in thirty-seven days; cavity and fistula closed in fifty-four days.

Rebecca S., sixteen years of age, was admitted to Cook County Hospital October 11, 1881. Her history was as follows: Her father died of acute consumption at about the age of thirty. Her mother is still living, thirty-four years of age, and enjoys good health. The patient's hygienic surroundings have been relatively good. She had rubeola and whooping-cough in her sixth year, but had no other sickness until two years and nine months before her admission to the hospital, when she had a severe attack of pleurisy on the right side, which kept her in bed for two weeks and terminated in an empyema. Aspiration was employed three or four times by her physician, Dr. Banga, at intervals of about a week, but difficulty was always experienced in drawing off the pus on account of its admixture with fibrinous matter, so that complete evacuation was impossible. One of the openings made by the aspirator needle remained open and discharged a considerable amount of pus daily for a year and a half. During this time, and until a year before her admission to the hospital, she had no medical treatment. At this time her general health began to be much impaired, she lost flesh and appetite, and became weak and anemic.

On account of this she consulted Dr. E. Andrews, of Chicago, who dilated the already existing opening into the pleural cavity, inserted through this a drainage-tube, and washed out the cavity with carbolic acid solution. The cavity was washed out daily until her admission to the hospital, and in consequence her health improved to some extent.

On admission the patient was found to be small for her age, spare, but not extremely emaciated; she was pale, her appetite poor, and she could not sleep without the use of hypnotics, rather because of her habituation to their use than on account of any especial pain in the side. The right half of the chest was sunken and flattened; the right shoulder was lower than the left; a slight curvature of the spine in the dorsal region, with concavity to the right, was noticeable, which had resulted, as is usual in such cases, from the sinking in of the right wall of the thorax. Two and one-half inches below and ½ inch to the right of the nipple, between the sixth and seventh ribs, was a fistulous opening leading upward and backward into the empyema cavity, and into which a probe could be passed 5½ to 6 inches. The amount of discharge was from 1½ to 2 tablespoonfuls daily.

Percussion resonance was clear over the clavicular and in the infraclavicular region, down to about the fourth rib, but dull from this point down to the liver. In the place of the clear percussion vesicular respiration was somewhat weak, but still could be distinctly heard. On the dorsal side there were clear percussion and vesicular respiration all over the scapula; in the infrascapular region, dull percussion and no respiration sound.

The heart and left lung were normal; temperature and pulse normal; bowels regular; urine light straw-colored, clear, acid, and contained neither albumin nor sugar. There has been no edematous swelling of the lower extremities at any time.

Daily washing out of the cavity with a 2.5 per cent. solution of carbolic acid was ordered, and a voluminous Lister dressing applied over the fistula. The patient was discharged from the hospital October 15th, and ordered to continue the treatment at home.

A month later, November 16th, the patient was readmitted to the hospital. During this time the daily discharge had decreased a little, but amounted still to about a tablespoonful. She has become weaker, her appetite poor, and complains of frequent pain in the right side and headache. The cavity was now washed out daily with a 0.1 per cent. solution of thymol, a Lister dressing applied, and quinin and iron given internally.

During December and January this treatment was continued, but no especial improvement was noticeable, notwithstanding the injection of different fluids, such as tincture of iodin, alternating with the solutions of thymol and carbolic acid.

In January she came under my care, and I resolved to try the thoracoplastic operation as a last resort to effect the closure of the cavity and check the suppuration. Once more the urine was carefully examined, both chemically and by the microscope, and was found not to contain albumin nor casts of any kind.

On January 27th, at the surgical clinic in the amphitheater of Cook County Hospital, in the presence of Dr. W. Meacher, of Portage, Wisconsin, assisted by the hospital staff, I operated in the following manner: The patient having been anesthetized with ether, was placed on her left side, and the right side of the thorax carefully disinfected with a 5 per cent. solution of carbolic acid and the nail-brush; the fistulous track was laid open for 1½ inches, when it passed inside the wall of the thorax, between the sixth and seventh ribs. The incision was then carried upward and backward along the outer surface of the sixth rib for about 3 inches, making the entire incision about 5 inches in length. By means of a gouge the sixth rib was now denuded of periosteum, and a piece 7 cm. long removed by a bone forceps. In the same manner 6 cm. of the fifth rib were removed. After this had been done I was able to introduce the little finger into the empyema cavity, which was found to be 2 inches long, 1½ inches high, and about 1 inch deep, extending up behind the fourth rib, the apex being at the third intercostal space. The upper border of the incision could be drawn upward beyond the fourth rib, which I denuded, and then removed a piece 6 cm. in length. Having a finger in the cavity and passing the other hand over the covering wall of the thorax, I ascertained that the pulmonary and thoracic walls of the cavity could be brought in contact, and so did not resect the third rib. The walls of the cavity were found to be firm, hard connective tissue, covered with a layer of flabby granulating tissue. All the latter was removed by the sharp spoon. The hemorrhage during the operation was trifling, no ligatures were needed, the slight hemorrhage from two of the intercostal arteries being stopped by torsion.

As the upper posterior end of the wound showed a tendency to form a pocket in the loose connective tissue below or anterior to the latissimus dorsi muscle, a buttonhole opening was made through the latter for a drainage-tube, near the angle of the scapula. The wound and the cavity were then thoroughly irrigated with carbolic acid solution, the walls dusted with iodoform, one large drainage-tube inserted into the cavity and another along the entire extent of the wound from the scapula to the anterior end of the old fistulous track, the wound united with disinfected silk, and covered externally by a layer of iodoform, over which a voluminous Lister dressing was applied. The carbolic spray was used during the operation, which lasted about an hour.

January 27th, 7 P. M.: Pulse, 136; temperature, 99.8° F. The patient has vomited a little, but is warm, and, with the exception of the high pulse, presents no evidence of shock.

January 28th, A. M.: Pulse, 114; temperature, 100.6° F. Has slept off and on, an hour at a time, from the use of hypodermic injections of morphin. Complains of pain in the side. 7 P. M.: Pulse, 124; temperature, 100° F. Complains of pain. Has taken champagne and a little milk and lime-water.

January 29th, A. M.: Pulse, 134; temperature, 101° F. Has slept for an hour at a time during the night. Complains of thirst and headache. Dressed the wound, which showed slight suppuration, and washed it out with thymol solution. 7 P. M.: Pulse, 148; temperature, 102.5° F. Ordered 5 grains of quinin every four hours; subcutaneous injection of ¼ grain of morphin when the pain is severe, and potassium bromid and chloral at bedtime, the latter to be repeated if she wakes during the night.

January 30th, A. M.: Pulse, 130; temperature, 101.2° F. She has slept well during the night, is somewhat nervous and feels feverish, but her general expression is good. P. M.: Pulse, 142; temperature, 102.6° F.

January 31st, A. M.: Pulse, 124; temperature, 101.5° F. P. M.: Pulse, 130; temperature, 102° F.

February 1st, A. M.: Pulse, 108; temperature, 100° F. P. M.: Pulse, 106; temperature, 100.2° F.

February 2d, A. M.: Pulse, 120; temperature, 98.5° F. P. M.: Pulse, 130; temperature, 100.2° F.

February 3d, A. M.: Pulse, 106; temperature, 99.5° F. P. M.: Temperature, 101.2° F. Wound dressed and stitches removed; discharge moderate. Patient sleeps better and has some appetite.

February 4th, A. M.: Pulse, 118; temperature, 99.7° F. P. M.: Pulse, 120; temperature, 101.7° F.

February 5th, A. M.: Pulse, 128; temperature, 99° F. P. M.: Pulse, 112; temperature, 99.5° F.

February 6th, A. M.: Pulse, 114; temperature, 99° F. P. M.: Pulse, 120; temperature, 100.6° F.

February 7th, A. M.: Pulse, 110; temperature, 99.2° F. P. M.: Pulse, 108; temperature, 100° F.

February 8th, A. M.: Pulse, 104; temperature, 98° F. P. M.: Pulse, 103; temperature, 99° F.

February 9th, A. M.: Pulse, 120; temperature, 99.2° F. P. M.: Pulse, 118; temperature, 98° F.

February 10th, A. M.: Pulse, 112; temperature, 99.8° F. P. M.: Pulse, 122; temperature, 100.6° F. Outer drainage-tube removed; very little discharge.

February 11th, A. M.: Pulse, 120; temperature, 98.5° F. P. M.: Pulse, 108; temperature, 99.8° F.

February 12th, A. M.: Pulse, 110; temperature, 98° F. P. M.: Pulse, 124; temperature, 99.6° F.

February 13th, A. M.: Pulse, 120; temperature, 99.8° F. P. M.: Pulse, 126; temperature, 101.2° F.

February 14th, A. M.: Pulse, 120; temperature, 100.7° F. P. M.: Pulse, 128; temperature, 101.1° F. The rise in temperature was accompanied by pain in the region of the wound and headache. She did not sleep well during the night, and complains today of considerable pain in the side. On the removal of the dressing a fluctuating swelling was sound just above the center of the united wound. As the contained pus could not be pressed out through the drainage-tube in the old empyema cavity, a small incision was made, through which about an ounce of somewhat fetid pus was evacuated. A small drainage-tube was now inserted, and the cavity washed out with a 2.5 per cent. solution of carbolic acid.

February 15th, A. M.: Pulse, 114; temperature, 98.2° F. Patient has slept well during the night, and the fever and pain have subsided.

February 21st: Very little discharge; removed the small external drainage-tube, and shortened the internal drainage-tube an inch.

March 5th: Discharge scanty; removed internal drainage-tube, and replaced it by sticks of iodoform and gum arabic, equal parts.

March 21st: Patient had headache and rise of temperature last night. No pain in the side. The wound is superficial and granulating. There is nothing to be found in the thorax to account for the transient rise in temperature.

March 22d: The patient was discharged from the hospital cured.

August 8th: The patient came to my office. Her condition was then as follows: The right shoulder was 1 inch lower than the left. The right clavicle, ½ inch lower than the left. The right angulus scapulæ, ¾ inch lower than the left. The arms being in a corresponding position, the distances from the spines of the vertebræ to the medial margin of the right scapula were, in the upper half 2, and in the lower half 1½, inches; to medial margin of the left scapula, 3 inches. When the elbows were pressed against the crest of the ilium the left arm was at all points in contact with the lateral wall of the thorax, but between the right arm and the lateral wall of the thorax there was a space of ¾ inch in the center and ½ inch at the axilla and above the crest of the ilium. The lower margin of the right pectoralis major had a horizontal portion 1¼ inches in extent; the left had none, or only about ¼ inch. About the nipple the circumference of the left thorax was 13¼ inches; of the right, 10¾ inches, measurements being made below the angle of the scapula. At the axilla the circumference of the left thorax was 13¾ inches; of the right, 11¾. In the region of the eleventh dorsal vertebra the circumference of the left thorax was 12½ inches; of the right, 10 inches. The anterior surface of the sternum was turned to the right. The deepest sinking in of the right pleural cavity was at a point just above the nipple, corresponding to the fourth rib, where the anteroposterior diameter was 3½ inches; at the corresponding point on the left side the diameter was 5 inches. Immediately below the clavicle the anteroposterior diameter on the right side was 3 inches; on the left, 3¾ inches.

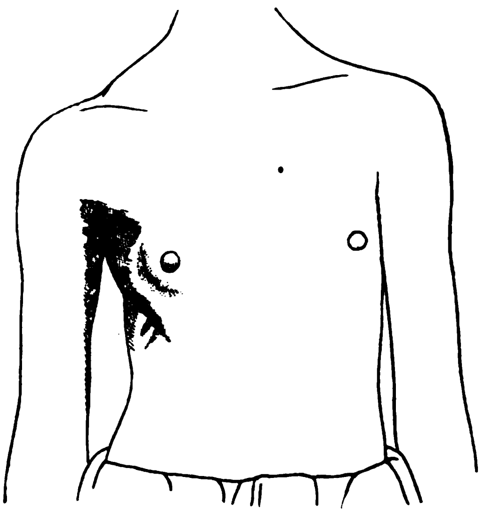

Fig. 34.—Appearance after recovery.

On the right anterior side there was clear percussion to the fourth rib; below this point, dull; in the axillary region clear percussion to the fifth rib; below this point, dull. On the posterior side percussion in the supraspinatous, infraspinatous, and interscapular regions was clear; in the infrascapular region, dull. There was vesicular respiration on the anterior side in the place of the clear percussion, and on the posterior side, except in the interscapular region, where the respiration had a hollow, bronchial character.

On the left side there was clear percussion down to the third rib, where the heart dullness commenced, extending from the left border of the sternum to the region of the nipple, where, between the fourth and fifth ribs, the apex-beat was perceptible. The heart and left lung were perfectly normal.

The scar shown in Fig. 34 was 4 inches long, extending from 2 inches below the right nipple, at about the sixth rib, upward and backward to the anterior border of the latissimus dorsi. Two inches behind and above the upper end of the scar was the cicatrix of the buttonhole opening for the drainage-tube.

In the dorsal region there was a slight curvature of the spine, the concavity to the right, the center of the concavity being at the eighth or ninth dorsal vertebra.

The patient has had monthly attacks of migraine, but neither pain in the chest nor cough.

The ends of the resected fourth, fifth, and sixth ribs could be plainly felt, but between them the wall of the thorax was so resistant that it was evident that formation of osseous tissue had taken place.

The patient's general condition was good. Her appetite was better than when the fistula was open, and she was not anemic.

From the beginning the empyema in this case was undoubtedly a total one; that is, it involved the entire pleural cavity, as was shown by the very considerable uniform diminution in size of the whole right thoracic cavity, which amounted to 2 and 2½ inches in the circumference, and from ¾ inch to 1½ inches in the anteroposterior diameter, of the thorax. As far as the extent of the empyema was concerned, this was one of the grave cases, and it is not surprising that even, as in this case, in a child less than fourteen years of age, the flexibility of the thoracic wall should not be sufficient to permit the sinking in necessary to bring it in contact with an almost entirely compressed lung. It is probable, however, that at the age of this patient, if the empyema had been properly treated from the beginning by timely incision and drainage, the lung, freed from the constant pressure of the large quantity of fluid contained in the cavity, might have been able to expand before the covering layer of connective tissue had become too thick and firm, so as to meet the wall of the thorax, and consequently a permanent cure might have been effected earlier, and a larger amount of lung tissue made available for future use. This is the more probable as in none of Estlander's cases was the thoracoplastic operation necessary in patients under twenty-one years of age, and it is certain that only in a child could so remarkable a diminution in the size of the thoracic cavity as was seen in this case have been possible.

In my case the effect of the operation, namely, the closure of the cavity and fistula, was very prompt, taking place in fifty-four days after the operation, or in twenty-two days less than Homén's average. This was to be expected, as Estlander's patients were older.

The immediate result of the operation was plainly to be seen in the remarkable sinking in of the thoracic wall in the region of the nipple, that is, over the fourth rib, where the anteroposterior diameter was lessened an inch and a half.

The idea of resecting pieces of the ribs in empyema is not a new one, as more than twenty years ago Roser advised the excision of a piece of a rib 3 to 6 cm. long, in order to get access to an empyema cavity and to avoid trouble in keeping the fistula open. For this purpose excision of the ribs has been in general use in surgery for a number of years, and is practised everywhere. Homén states that an American surgeon named Walter,* in 1857, resected an inch of the eighth rib in a case of intractable fistulous empyema because he thought that caries of the rib might possibly be the cause of the suppuration. As no improvement took place, two months later he resected two inches each of the eighth and ninth ribs for the same purpose. The fistula closed up a year afterward.

It is thus evident that Walter had made a thoracoplastic operation, but without being exactly aware of the idea of the procedure. Simon, in 1869, was aware of the fact that after resection of a rib for empyema the cut ends of the bone soon approached each other, and he laid stress upon the fact as a means of diminishing the size of the empyema cavity.

Heineke, in 1872, proposed to remove a piece of the rib covering the fistula 7 cm. in length for the same purpose.

To Estlander belongs the undisputed merit of having systematized the operation, extended it to the resection of as large a number of ribs as the size of the cavity may require, and reported a series of eight operations,† in fact, Estlander has proved not only the practicability of the method, but also its great value. In reality the operation is Estlander's, and it, therefore, seems proper to accept the name thoracoplastic given it by him.

Indications for the Operation.—As already stated, the thoracoplastic operation will have to be resorted to in cases of intractable empyema cavities that have resisted all other treatment. But the question arises: When in the course of such an empyema is it time for the operation? Naturally, it is impossible to fix a stated time that will apply to all cases and ages, but Estlander strongly advocates that the operation shall not be made early, as he considers it a *conditio sine qua non* for a beneficial result of the operation that both the pulmonary and costal pleuræ shall have been transformed into a thick layer of firm connective tissue, with its great inherent retractive power. Homén gives, as an approximate rule, that when the fistula has existed four or five months without any diminution of the cavity, the operation should be resorted to. As the disease has probably existed for two or three months before the fistula, the time for the thoracoplastic will be six to eight months after the beginning of the disease.

The fact that the cavity is not diminishing in size should be ascertained by careful watching of the patient; when the successive injections into the cavity show the quantity of the injected fluid to be the same, and when, on probing the cavity with uterine sound or metallic catheter, its dimensions are found to remain materially the same.

It is a question, however, if it would not be appropriate to operate somewhat earlier, as Homén has stated that the earlier the empyema operation is performed, the more quickly will the fistula heal up in favorable cases, and it is evident that the thoracoplastic operation is liable to be more effectual when the layer of connective tissue covering the lung and the wall of the thorax is of moderate thickness, instead of being firm, hard, thick, and unyielding in any direction. Furthermore, one of Estlander's main arguments for delaying the operation until the pleura has been transformed into a thick connective-tissue membrane is this: That the pleura has lost its character of serous membrane, and thus the danger of opening into a pleural cavity is obviated.

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* Brit. Med. Jour., 1860, vol. i, p. 48.

† Revue Mensuelle de Médecine et de Chirurgie, 1879, vol. iii, p. 1885.

His reasoning here is not quite correct, because at no period of an empyema is there any danger from opening the pleural cavity under antiseptic precautions in adults, and, besides, if the empyema cavity be local, that is, only a part of the whole pleural cavity, there is no likelihood of opening or cutting into healthy parts of the pleural cavity during the operation, as the adhesions necessarily surrounding the empyema cavity will probably always be extensive enough to prevent such an accident, and in most cases no serous or healthy parts of the pleural cavity will be found at all.

As contraindications, advanced tuberculosis of the lung, albuminuria, and extreme debilitation of the patient naturally present themselves. Of the first two named, the albuminuria from amyloid kidney is probably the most important, as such patients are liable to succumb to the shock of even a not very serious or prolonged operation. As to the third contraindication, the debilitation of the patient, Estlander has shown that in patients emaciated almost to a skeleton, and so weak that they could take only a few steps, and in one in which the patient was so weak that he could hardly turn himself in bed, the operation has caused very slight transitory derangements in the patient's condition, and that the slight fever and pain following the operation have disappeared in a few days, to be followed by a remarkable, almost constant, improvement. It is thereby shown that the operation is by no means an exhausting one, but may be resorted to in cases where the patients are extremely debilitated.

Operation.—In deciding upon the plan of operation in each special case, the first consideration is naturally the shape and size of the cavity, and the plan will be essentially different when the cavity has its greatest length from above downward in a perpendicular direction, and when its direction is transverse from before backward. A longitudinal cavity covered by five, six, or seven ribs, and not extending from the sternum to the vertebral column, but occupying only part of the thoracic cavity, will usually have the greatest depth in the axillary and infra-axillary regions, and will require the resection of small pieces, that is, from 2 to 6 cm., of a large number of ribs. In one of Estlander's cases, in two successive operations, 2 to 6 cm. were resected of not less than nine ribs—from the third to the eleventh inclusive.

The first and second ribs are, as a matter of course, so inaccessible and, also, so near the large vessels, that they are out of the question for resection. The twelfth rib is too short and too movable ever to require the operation.

A transverse cavity requires the resection of a larger piece of one or a few ribs. As to the length of these pieces, Homén, from a rather theoretic point of view, by mathematic deductions, gives the rule that there should be resected of each rib a piece the length of which is equivalent to the greatest distance between the inner surface of this rib and the pulmonary surface of the cavity. Consequently, of several ribs covering the cavity the largest piece will have to be resected from the rib extending over the middle of the cavity. In the main these theoretic deductions will be found practically applicable.

The most important muscles interfered with are the pectoralis major and the serratus anticus major. When the resection is made strictly subperiosteally, there will be the same rehabitation of functions of these muscles as in the subperiosteal excisions of joints, a more or less extensive formation of new bone always taking place in the periosteal sac of the excised ribs.

The incision varies according to the number of ribs to be resected. For the excision of long pieces of two or three ribs one single incision parallel to and either between the two, or along the middle rib of the three, will give sufficient space for the removal of the pieces, especially when, by sinking in of the thorax, the ribs are in more or less close approximation to one another.

For the excision of small pieces of a large number of ribs it is best to make several incisions parallel to and above each other in the intercostal spaces, each incision permitting the excision of two ribs. Estlander attempted in such cases to make one vertical incision for the resection of several ribs, but found it inconvenient, as he was obliged to make several secondary incisions at right angles to the first, and so made an irregular wound, requiring several drainage-tubes, and which was slow and somewhat difficult to heal.

Through the incision in the skin the periosteum is divided along the external surface of the rib and stripped from the latter by a common gouge. This is usually accomplished without difficulty. Occasionally it is rendered more difficult when, by sinking in of the thorax, the ribs are pressed together, and sometimes even overlap. To perform the operation in such cases it would be necessary to commence with the most superficial rib, of course.

As a matter of course, the ribs should not be denuded of periosteum beyond the location of the piece to be excised, with the view, as Homén states, of avoiding necrosis of part of the resected rib. Fear of such a necrosis would be unnecessary if all excision wounds healed by first intention. But this will, as a rule, not take place, because the wound is in connection with an already suppurating cavity, from the walls of which, by the most careful scraping out, all the inflammation-producing germs cannot be removed.

The hemorrhage is always insignificant; Estlander has never been obliged to make a single ligation.

If the cavity is small and the walls sufficiently firm, it may be well to remove the soft suppurating layer of granulations with the sharp spoon, providing the cavity is so situated that no important organs are thereby endangered, for the following reason: If the thoracoplastic operation is sufficient to produce perfect approximation of the walls of the cavity, the scraping out might make closure by first intention possible.

A counteropening from the cavity to the posterior wall of the thorax at the latissimus dorsi muscle is desirable, if not necessary, if the cavity is of considerable size.

The external wound should, of course, be united, drained, and dressed antiseptically.

The *after-treatment* lasted generally about ten weeks in the cases in which recovery took place. The fever following the operation was always moderate. The rather constant and more or less violent pain in the operation wound was remarkable. It usually lasted only for a few days, and was easily overcome by morphin.

The wound should be dressed every two to four days, according to the amount of discharge, accompanied by washing out with antiseptic fluids through the drainage-tubes. How far the theoretic rational advice of Homén to assist the sinking in of the thoracic wall operated upon, by local pressure upon it, is practicable, cannot yet be stated. In my case it was impossible to resort to this measure because of the pain in the side, which did not permit me to apply the common dressings even as firmly as I wished, but obliged me to apply the roller-bandages as loosely as possible and still hold the dressings in place.

An important question during the after-treatment is to determine the progress of the diminution of the cavity, by means of the quantity of fluid injected and the probe. When it is found that a cavity comes to a standstill, a second or even a third operation may have to be resorted to. The time between the two operations in the same case has varied from six weeks to five months.

The thoracoplastic operation should undoubtedly be accepted as a valuable, if not a necessary, final step in the treatment of empyema, a general view of which would be nearly as follows: As soon as the diagnosis of an empyema is thoroughly established, aspiration should be first resorted to if the pus in the pleural cavity is not fetid. If, after repeated aspirations, the fever does not decrease nor the lung expand, and the cavity refills rapidly, the empyema operation by incision *in loco selecto*, and counteropening in the lowest part of the cavity, with resection of a piece of rib, if necessary, and thorough drainage and washing out, is in order. This operation should be performed as early in the disease as possible, as the statistics have shown that the earlier it is performed the better are the chances for recovery.

Finally, if this operation does not procure complete recovery, that is, complete closure of the cavity within about six months, the thoracoplastic operation should be performed, and, if necessary, be repeated until perfect recovery is obtained.

Estlander has established beyond doubt that some lives otherwise lost may be saved by this operation, and I am glad to do honor to the memory of a man with whom I have been in friendly relations in former years, and whose premature death is a deplorable loss to science, by bringing his operation before the notice of the profession of this country.

REPORT OF A CASE OF PENETRATING WOUND OF THE ABDOMEN AND SMALL INTESTINE*

THE case to which I desire to call your attention today has a certain practical importance, mainly because it belongs to the class of traumatic and consequently acute injuries, which any of you may occasionally meet with in your future practice, and in which prompt action will be required of you—action so prompt as not to admit of the delay which the obtaining of skilled assistance would cause, and an action on the promptness of which the patient's life depends.

The history of the patient whom I now present to you is as follows: Pascale Copelli, an Italian who has been only a short time in this country, forty years of age, a shoemaker, was admitted to the Cook County Hospital at 4 P. M. November 14, 1881. An hour before admission, while engaged in a dispute over cards, he was stabbed with a stiletto in the left side of the abdomen, causing the protrusion of a mass of the small intestines from 8 to 10 feet in length. The weapon also passed obliquely through the intestine, inflicting an incised transverse wound about an inch in length. He became unconscious after receiving the injury, and was brought immediately to the hospital and placed under my care. When I was called to see the patient I had just finished an autopsy lecture in the dead-house, and consequently, as I did not wish to operate upon or even to handle the prolapsed intestines, I requested the house surgeon, Dr. B. C. Meacher, to perform the operation.

On examination, an incision through the abdominal wall was discovered, just in front of the left anterior-superior spine of the ilium. Eight to 10 feet of the small intestine which had prolapsed from the abdominal cavity were wrapped up in some old garments, after the removal of which, and some blood, partly fluid and partly clotted, a transverse incision, an inch in length, passing through the peritoneal and muscular coats of the intestine, was found on the convex side of one of the loops. In the central part of the incision the mucous membrane protruded like a hernia, and constant bleeding took place from severed vessels in the submucous tissue of the intestine. No fecal matter or air escaped through the incision, probably because the mucous membrane was not entirely perforated.

Dr. Meacher now proceeded to unite the wound in the intestine in the following manner: A slightly curved needle, armed with medium-sized catgut, was introduced on one side, and ½ inch from the edge of the incision passed through the peritoneal and muscular coats in the submucous tissue, down toward the wound for about ¼ inch, and then brought out ¼ inch from the edge of the wound; reintroduced ¼ inch from the opposite edge of the wound, passed through the wall of the intestine in the manner described above for ¼ inch, and finally again brought through the surface. Six such sutures, distant about three lines from each other, were found to be sufficient for the perfect closure of the wound in the intestine. When these sutures were tied, the hemorrhage from the intestine ceased, and a perfect juxtaposition of the peritoneal surface surrounding the wound was effected to the extent of about ½ inch. The mass of prolapsed intestines and the anterior wall of the abdomen were now carefully cleansed by irrigation with a 2.5 per cent. solution of carbolic acid. Numerous small adherent clots of blood were removed by disinfected sponges and a dressing forceps, and the prolapsed intestines replaced through the opening in the abdominal wall, not without difficulty, as there was considerable hemorrhage from the abdominal wound.

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* Clinical lecture delivered at Cook County Hospital. Chic. Med. Review, 1882, vol. v, p. 11.

As the opening in the skin was not large enough to allow of thorough examination of the deep parts of the wound, the wound through the integument was dilated about an inch upward and downward, after which it was seen that the opening through the muscles and peritoneum was larger than the original opening in the skin. Two bleeding vessels in the bottom of the wound were caught up and ligated, and thereafter the blood which had entered the abdominal cavity was removed. The latter procedure was effected by means of small disinfected sponges on sponge-holders, which were introduced upward and downward over the whole region of the abdomen, and which brought out a moderate quantity, perhaps two ounces, of blood, partly fluid and partly clotted. Having thus thoroughly cleansed the peritoneal cavity, the wound in the abdominal wall was united by deep and superficial sutures, a drainage-tube inserted in the wound of the abdominal wall only, not extending through the peritoneal wound. Antiseptic dressings were applied and retained in position by a cincture around the abdomen and a spica bandage.

After the operation the patient's pulse was 102; temperature, 97° F. The patient showed no evidences of shock when he awoke from the narcosis. He was ordered on absolute diet—that is, he was not allowed to eat or drink anything. For thirst or dryness he was allowed to keep small pieces of ice in the mouth.

November 15th, A. M.: Pulse, 126: temperature, 99° F. Tincture of opium, given with the ice, was vomited up twice and was subsequently given per rectum. He rested well during the night and complained of no pain. P. M.: Pulse, 108; temperature, 98° F.

November 16th, A. M.: Pulse, 90; temperature, 99.2° F. The patient slept well and has had no recurrence of the vomiting. He has a little tympanites of the abdomen, but no diffused pain, and a feeling of soreness only around the wound. P. M.: Pulse, 90; temperature, 99.4° F.

November 17th, A. M.: Pulse, 90; temperature, 99.2° F. Has slept well, and complains of slight pain in the region of the wound. Is getting hungry. P. M.: Pulse, 90; temperature, 99° F.

November 18th, A. M.: Pulse, 84; temperature, 99.2° F. P. M.: Pulse, 90; temperature, 99.6° F. Milk and wine were administered per rectum.

November 19th, A. M.: Pulse, 84; temperature, 98.4° F. The pain in the abdomen subsided after the passage of flatus through a rectal tube. The patient feels well, but is hungry and constantly calling for something to eat.

November 20th, A. M.: Pulse, 88; temperature, 98.4° F. The patient was given some oyster soup last night, and complains of a little pain in the left side, but there is no tympanites.

November 23d: Pulse, 76; temperature, 98.4° F. The wound was dressed, and the sutures and drainage-tube removed. Perfect union by first intention was obtained. The patient was still confined to liquid diet.

November 26th: Pulse and temperature normal. The bowels moved for the first time since the operation, without the use of a laxative.

November 27th: The patient is up, walking about the wards, and feels well.

November 30th: He is allowed solid food in moderate quantity.

December 5th: The patient is walking about the whole day and feels perfectly well.

December 8th: Discharged, recovered.

This case illustrates one of the important questions in modern surgery—the treatment of wounds of the intestines. The treatment has undergone some changes in the last decad, and to these I now desire to call your attention. Prior to this time the suture of wounds in the intestines was regarded as so unsafe a procedure, as regards the perfect and reliable closure of the wound, that the opinions of surgeons as to its treatment were divided. Even in cases of smaller wounds, longitudinal or transverse, the latter dividing only a portion of the circumference of the intestine, the more cautious portion of the surgical fraternity advised that the wound be united with the opening through the abdominal wall, so as to be assured that all fecal matter should be evacuated through the wound, and that none should penetrate into the peritoneal cavity. By this treatment an artificial anus was the inevitable result.

The more rational, but at the same time more daring, party of surgeons knew, from the results from the suture advised by Lembert, that it was possible to unite intestinal wounds by first intention, thus avoiding the necessity of an artificial anus. But in a number of cases in which Lembert's suture had been used union by first intention did not take place, and consequently, after the replacing of the intestine, a perforating peritonitis set in and frustrated the results of the operation. Thus the matter stood, between an artificial anus, with its well-known serious inconveniences, sufficient to make the patient's life miserable, but saving his life, on the one hand, and, on the other hand, the dangerous method of suture, in which non-union and consequent perforating peritonitis were to be feared.

In this as in many other fields of surgery, the doctrines of antiseptic surgery—that is, aseptic material for operating and dressing, combined, of course, with the more minutely developed technicalities—have entirely changed our views on the subject. We are now enabled, not only in smaller longitudinal and transverse wounds, but also in wounds dividing the whole lumen of the intestine, extending down even into the mesentery, to effect, by the careful appliance of sutures, a perfect union by first intention, thus avoiding the inconvenience of an artificial anus. Lembert's principle of uniting the peritoneal surfaces will always be the guiding one. But the acquisition due to modern surgery we owe to one of Billroth's operations for extirpation of the stomach, in which it was found that, notwithstanding the use of aseptic silk sutures, minute quantities of fecal matter passed out along a suture penetrating through the layers of the intestine. The consequence of this experience was naturally the rule that sutures should be passed within the coats of the intestine, or, in other words, that the sutures should be passed from the peritoneal surface down into the submucous, and from this out again through the peritoneal surface, so as to prevent a penetrating wound of the intestine from the needle. Any longitudinal or transverse wound of the intestine can be united in this manner, and if so united, which depends to a great extent upon the manual dexterity of the surgeon, it will necessarily unite by first intention without any danger of perforating peritonitis.

The material for sutures, when aseptic, whether Czerny's silk or Lister's catgut, is not very important, for the following reasons: First: The inabsorbable silk will be encapsulated and be permanently innocent when not in contact with the fecal matter of the intestines. Second: The absorbable catgut, if it remains unabsorbed for two days only, will afford sufficient security of union if the intestines are kept quiet, as the peritoneal surfaces require only about thirty-six hours for primary agglutination.

In the more extensive wounds of the intestine, in which the whole of its circumference is divided and the wound penetrates down into the mesentery, the operative procedure is of the same general character, and only a few technical differences are necessary to secure the perfect union of a sufficiently large area of peritoneal surface. The procedure I should advise in such cases is the following: Divide the mesentery perpendicularly, sufficient to permit of the invagination of about ½ inch of the intestine. Unite the entire circular wound with a sufficient number of Lembert's sutures, either penetrating the intestine or not. Then invaginate the upper portion of the intestines to the lower to the extent of about ¼ inch. Secure this invagination before taking this last step in the operation by a sufficient number of non-perforating sutures. Effect the invagination simultaneously with the knotting of the sutures, and finally apply a similar number of intermediate superficial sutures of very fine silk or catgut, taking in as far as possible only the serous membrane.

There is one and only one serious difficulty in the carrying out of this procedure: namely, can we always be certain which is the upper or afferent, and which the lower or efferent, section of the intestine? The answer to this question must be that in a number of cases we cannot tell. Our knowledge of normal anatomy must be our only guide here. Whenever examination of the prolapsed intestines, either alone or combined with palpation, reveals some of the well-known anatomic landmarks, as the upper end of the jejunum, the cecum, or any of the flexures of the colon, or the rectum, we may then be able to distinguish between the upper and lower end of the intestine. But if we have to deal with one or more ansæ of the small intestine, and we do not deem it advisable—which I should not feel inclined to do from the present standpoint of surgery—to draw out through the abdominal wound a larger part, if not the whole, of the small intestine for the purpose of ascertaining the exact location of the wound, then we will have to take our choice between the divided ends of the intestine and make the invagination at haphazard.

The inconvenience or, to go a step farther, the danger from the invagination of the efferent into the afferent end of the cut intestine has a purely mechanical importance. It is obvious that the invaginated portion, when pointing against the current of the fecal matter in the intestines, will form a circular valve that will be closed, by the force of the current, more or less perfectly, the amount of closure being dependent partly upon the diameter of the valve and partly upon the diameter of the intestine operated upon. In other words, the broader the valve and the smaller the intestine, the greater the danger of occlusion, or of some impediment to the passage of fecal matter. Consequently the danger is not very great in such places as the colon or the ventricle. In the small intestine the danger of occlusion must be guarded against, but as the cases thus far recorded are so few, it is impossible to tell how great the real danger is.

In a case operated upon by Dr. Madlung, of Bonn,* in which, during the extirpation of a tumor in the mesentery, the removal of about 10 cm. of the small intestine was necessary, and the efferent portion of the intestine was invaginated into the afferent for about ¾ inch, the narrowing of the small intestine thus caused occasioned paroxysmal attacks of colicky pains and vomiting whenever anything except liquid diet was given. Even very small quantities of crackers or finely minced meat would cause these attacks, which were overcome without serious consequences by the use of castor oil and other laxatives, but, nevertheless, caused considerable alarm to the patient as well as to the operating surgeon for more than a month after the operation, and necessitated a very slow and careful transit from liquid to the ordinary diet.

This case shows us that we must expect this disagreeable intercurrent complication in the after-treatment of operations on the small intestine, even if we know the exact locality of the portions of the intestine to be united; and in cases where the efferent end of the intestine has been invaginated into the afferent end the liability is much greater. Cases in which the latter procedure has been effected and followed by fatal intestinal obstruction are not yet on record, but in my opinion the two following precautions should be observed in the performance of the operation: First, not to make the invagination more extensive than is absolutely necessary for safe union—say ½ inch. Second, keep the patient on liquid diet, if necessary, even for several months after the operation. This latter inconvenience, even if it has to be kept up for six months after the operation, will be amply repaid by the consequent avoidance of the misery of an artificial anus.

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* Berlin. klin. Wochenschr., 1881, vol. xviii, p. 75.

THE TOTAL EXTIRPATION OF THE UTERUS THROUGH THE VAGINA.[*]

THIS important operation is one of the latest conquests of modern, that is to say antiseptic, surgery, and for the right to carry out this operation into practical life we are indebted to Czerny, Schröder, Billroth, and Mikulicz. This is another illustration of the old saying that "there is nothing new under the sun," as total extirpation of the uterus was not only thought of, but performed, as far back as 100 A. D., by Soranos, and in the course of the following centuries was occasionally performed in cases where a prolapse of the organ made the extirpation both imperatively indicated and reasonably practicable in conformity with the status of surgery at that time.[†]

But it was not until the commencement of the present century, with its numerous and fruitful impulses in the direction of methodic and scientific progress in our science, that any serious attention was directed to this subject. Mikulicz, in his interesting monograph on this subject,[‡] states that a prize was offered by the Josef's Academie of Vienna for the best essay on this subject, and the prize was awarded in 1814 to Gutberlet, who proposed a method of extirpation by abdominal section which resembled in its main features Freund's method, and was performed sporadically several times in later years, and then fell into disuse, until Freund, half a decad ago, by the aid of the antiseptic method, again brought it systematically before the profession.

The prognosis of this abdominal operation in the course of a few years was shown to be so unfavorable that Ahlfeld's statistics, founded on not less than 66 cases, showed a mortality of 49, that is, 74 per cent., caused by the operation itself; 4 operations had to be abandoned, and only 13 patients, or about 20 per cent., recovered. It was natural that an operation so dangerous in itself, if not entirely abandoned, would at least lead the profession to consider very seriously the question of the attainment of the same end by a safer method of operation.

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[*] Amer. Jour. Med. Sci., 1882, vol. lxxxiii, p. 17. Read before the Chicago Medical Society November 7, 1881.

[†] The first extirpation of the prolapsed uterus in this century was made by K. M. Langenbeck, for cancer, in 1813. The patient recovered, and the case was for many years the occasion of unjust doubt and criticism in the literature, until finally, thirty years after, the autopsy showed that the operation had been complete. It was Langenbeck's description of his operation that led Czerny to extirpate a non-prolapsed uterus through the vagina. It is needless to state that the extirpation of a prolapsed uterus is much easier, and in reality an entirely different, operation from that which we are now considering, because not only the fundus uteri, but also the broad ligaments and ovaries, are usually outside of the vulva, and within easy reach of the operator. Consequently there is no great technical difficulty in the operation.

A recent case of the extirpation of a prolapsed uterus was reported in 1880 by Dr. John C. Blake (Boston Medical and Surgical Journal, April 14, 1881), in which no cancer was demonstrated. His method of operation is rather difficult to comprehend, and his ligature *en masse* of the whole amount of tissue above what he calls the "fundus," but which probably was the cervix, is so primitive a procedure that I should deem it hardly permissible at the present time. The patient died twelve hours after the operation. The cause of death was unknown, as no autopsy was made.

[‡] Wien. med. Wochenschr., 1880, vol. xxv, p. 1281.

The total extirpation of the uterus through the vagina had previously been performed in isolated cases. In all probability the first operation of this kind was performed by Sauter in 1822, from which the patient recovered, notwithstanding the opening of the bladder. Récamier operated in 1829 in one case with good results, and, after him, several others, but usually with fatal results. The operation was consequently abandoned until Czerny reintroduced it with one successful case in 1879.* The first successful case was speedily followed up by Billroth and Mikulicz in Vienna, and Schröder in Berlin. To the latter we are indebted for our knowledge of the comparative safety of the operation, as in 1881 he issued a most brilliant statistical report† of 8 operations with 7 recoveries and only 1 death, which was not caused by peritonitis or septicemia, but from a probably unavoidable internal hemorrhage from a ruptured vessel in one of the broad ligaments.

The operations reported in the literature accessible to me up to the time of my operation were the following:

OPERATOR.	CASES.	RECOVERIES.	DEATHS.	UNFINISHED OPERATIONS.
Czerny	2	2	0	0
Billroth	7	4	3	0
Schröder	8	7	1	0
Merike ‡	1	1	0	0
Tarsini §	1	1	0	0
Martin ‖	12	6	3	3
Olshausen ¶	6	6	0	0
Bauer	4	2	2	0
Lane	1	1	0	0
Kaltenbach	1	1	0	0
Bompiani	1	0	1	0
Bardenheuer	1	0	1	0
Total	45	31	11	3

As will be seen from the above tabular statement, 69 per cent. of those operated upon recovered, 24 per cent. died, and in 7 per cent. of the cases the operation was unfinished. Taking into consideration that the statistics, although from a relatively small number of operations, still showed such unexpectedly favorable results from a new and almost untried method, I did not hesitate, after careful investigations upon the cadaver, to resort to the operation in the following case:

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* "Ueber die Ausrottung des Gebärmutterkrebses," *ibid.*, 1879, vol. xxix, p. 1172.

† Zeitschr. f. Geburtshülfe und Gynäkologie, 1881, vol. vi, p. 226.

‡ "Bericht über die Verhandlungen der Gesellschaft für Geburtshülfe und Gynäkologie zu Berlin," Zeitschr. f. Geburtshülfe und Gynäkologie, 1881, vol. vi, p. 415.

§ Gazetta Medica Italiana Lombardia, 1881.

‖ Centralbl. f. Gynäkologie, 1881, vol. v, p. 189.

¶ "Ueber total Extirpation des Uterus nach 10 eigenen Fällen," Berlin. klin. Wochenschr., 1881, vol. xviii, p. 497.

CASE.—*Mixed cylindric- and multiform-celled carcinoma of the cervix and lower half of the fundus of the uterus, of over eight months' standing. Enlargement of the fundus. No tangible infiltration of the broad ligaments, bladder, rectum, or vagina. Total extirpation through the vagina. Opening of the bladder. Permanent irrigation. Slight transient cystitis. Slight rise in temperature for two weeks. Temporary vesicovaginal fistula, which closed spontaneously after four weeks. Complete recovery from the operation.*

Mrs. H., forty years of age, parents still living and healthy. No consumption or cancer in the family. She has always been spare, but otherwise healthy. Menstruation commenced at fifteen and has always been regular. She was married at eighteen and has had 9 children. Delivery was always easily accomplished without the aid of forceps. Of the 9 children, the first 2 died when eighteen months old, and the fifth when two years old, from diphtheria.

Eighteen months previous to the operation she became pregnant, until which time her menses were regular. Toward the end of pregnancy, however, she felt more tired and weak than had been usual when in this condition, and, when standing, she would have a feeling of bearing down or pressure in the lower part of the pelvis, which was of a more distressing character than that experienced during any of her former pregnancies. There was never any hemorrhage, but often considerable pain, irradiating from the pelvis down the left leg.

In due time—nine months previous to the operation—she was delivered, and during the act of delivery noticed a peculiar cutting character of the pains, which she had not experienced in former confinements, and the after-pains, during childbed, which lasted for nine days, were, she noticed, of a similar character. There was less hemorrhage than usual during this time. When she got up she experienced a sensation as if something heavy had been left in the pelvis, and a few weeks later, when she had recovered her usual strength, she felt pulsation, dull pain, and bearing down, giving her the idea that something was not as it should be. The midwife who attended her told the relatives that while exploring during the delivery she had felt something unusual, like a hard lump.

Nine weeks later a slight hemorrhage set in, which continued more or less up to the time of operation, and which occurred in the following way: Every two or three days she would have bearing-down pains, and a sensation as if something turned around, and then suddenly a quantity of blood would be discharged at once, after which there would be no hemorrhage for a couple of days, when the same series of symptoms would recur. The quantity of blood discharged increased slowly but gradually from month to month, until in July, 1881, the hemorrhages became so severe and the intervals so short that she was obliged to remain in bed for three weeks. During this time she made use of some medicine internally, and the hemorrhage ceased, but returned when she got out of bed. In the latter part of August and September the hemorrhages were less severe, but would still recur every two or three days, accompanied by the usual symptoms.

During the whole summer of 1881 she lost strength, her appetite became poor, and her condition more and more anemic. August 14th I was called to see her, in consultation with Dr. Mead. The examination showed the following condition: The patient was pale, thin, of medium height, weight about 130 pounds; lips and conjunctivæ pale; lungs and heart normal; the abdominal walls somewhat flabby, but palpation and percussion normal. Vaginal examination revealed considerable enlargement of the vaginal portion of the uterus; the external os was sufficiently large to admit the end of the finger, and hard, irregular, and nodulated to the touch. In the anterior and posterior lacunæ no isolated tumors could be felt. Combined external and internal examination showed the uterus to be movable and the fundus somewhat enlarged, but not particularly tender. There was no enlargement of the ovaries, and no hardness or thickening or nodulated condition of either of the broad ligaments, but palpation of the broad ligament on the right side, with deep pressure, caused her some pain. Combined vaginal and rectal examination revealed no thickening of the rectovaginal tissues anywhere, and palpation of the bladder through the anterior lacuna did not reveal any hardened tissue outside of the thickened vaginal portion. After the introduction of Sims' speculum the vagina was found to be filled with blood, after the removal of which the vaginal portion of the uterus was seen to be enlarged to a large tumor of about 1½ inches in diameter. The external os formed a funnel-shaped cavity, 1 cm. deep and 1.5 cm. in diameter, presenting an excavated, irregular, cancerous ulcer, partly covered with discolored, grayish-white, necrotic tissue, partly with grayish-red tissue, from which a considerable hemorrhage was steadily going on. The remainder of the vaginal portion had a whitish, somewhat nodular appearance, but was covered all over with healthy mucous membrane; in the posterior and anterior lacunæ, as well as in the rest of the vagina, the mucous membrane was normal, and no isolated cancerous tumors were to be seen anywhere. The uterine probe showed the uterine canal somewhat enlarged, and about 4 inches in length. A piece of the vaginal portion was removed from the border of the ulcer for microscopic examination. The urine was dark colored, clear, acid, and contained neither albumin, sugar, nor blood, and no cellular elements of any kind.

Microscopic examination of the hardened piece of excised tissue showed epithelial carcinoma, with large, irregularly shaped alveoli, wholly or partly clad with a single or double layer of cylindric epithelial cells, and filled and partly clad with large, multiform epithelial cells with large oval nuclei.

Diagnosis.—Epithelial carcinoma with preponderating cylindric epithelial cells, originating in the mucous membrane of the cervix uteri, involving the whole of the tissues of the cervix, and probably extending high up in the cavity of the uterus. No extension of the carcinoma, either into the rectum or bladder, or to any palpable degree into the broad ligaments.

The following plan for an operation was proposed and accepted. Everything was to be prepared for the total extirpation of the uterus through the vagina; the operation to be commenced with a view of making a supravaginal amputation only, if this procedure would enable me to remove the whole of the diseased tissue. But if this proved insufficient, the total extirpation of the organ should be immediately performed.

As the patient stated that at regular intervals she had sensations, though indistinct, similar to those during her menses in former times, but which still were distinct enough to enable her to differentiate between such a period of hemorrhage and the continuous hemorrhage described above, I resolved to wait for two weeks until one of these periods should be just over before proceeding to operate, as in one of Schröder's cases considerable pain and distress had occurred during the after-treatment of an extirpation just at the time at which the patient expected her menses to set in.

In the second week of September the patient stated that the hemorrhage was accompanied by the usual sensations of the period, which terminated about the fifteenth of the month, and consequently the nineteenth was fixed upon as the day of operation. During this interval of four days the following preparatory treatment was enacted: The patient was kept in bed most of the time; kept on liquid diet; the bowels were moved every day by the use of compound licorice powder at bedtime, and the vagina was washed out twice a day with 3 per cent. solution of carbolic acid, which sometimes caused slight burning sensations in the vulva.

Operation.—On September 19th, assisted by Drs. S. D. Jacobson and E. W. Lee, of the staff of Cook County Hospital; Dr. Truman W. Miller, of the United States Marine Hospital Service; Dr. J. B. Murphy, of Chicago; Dr. Bradley, House Surgeon, and Dr. Kendall, Interne of Cook County Hospital, I operated in the following manner:

The patient was anesthetized with ether by Dr. Kendall; placed in the lithotomy position on a table immediately opposite a window, through which the sunlight would thoroughly illuminate the field of operation. Dr. Lee, standing on the left side of the patient, made compression of the abdominal aorta. Drs. Jacobson and Miller, on the right and left side of the patient, held the femora, and each held also a Simon's speculum in the vagina. Dr. Murphy, at my right hand, had charge of the carbolized sponges for cleansing the field of operation, and Dr. Bradley, at my left hand, had charge of the instruments.

By means of a strong vulsellum forceps the vaginal portion of the uterus was drawn down toward the vulva, but the cancerous tissue in which it was inserted was so friable that the forceps tore through several times, and only a moderate degree of force and traction could be employed. By means of a slightly curved scissors a circular incision was made through the vaginal mucous membrane, at the upper circumference of the vaginal portion, about 1.5 cm. from the ulcerated surface of the os. The loose, submucous connective tissue was separated with blunt instruments, so as to detach the bladder and rectum from the tumefied neck of the uterus. In detaching the posterior wall of the bladder from the latter it was found that hard cancerous tissue had infiltrated a part of the muscular coat of the bladder, and in removing this infiltrated tissue the bladder was opened, notwithstanding that its neck was held down toward the vulva by introduction through the urethra of a urethral sound having a short curve. The opening in the bladder represented a transverse slit 1½ to 2 inches in length. The wall of the bladder posterior to the opening was taken hold of by a long hemostatic forceps and held up toward the symphysis pubis. A heavy double silk ligature was passed through the upper part of the neck from the posterior to the anterior surface, the ends knotted, and the ligature used as a loop by means of which the uterus was drawn further down toward the vagina. In both lateral regions the connective tissue was too resistant to be detached from the sides of the neck by blunt instruments, and on this account I was obliged to cut it through with the curved scissors. This necessitated the ligation of several small vessels.

The whole of the neck having thus been exposed, the uterus was drawn further down, but the loop of heavy silk thread tore through the soft cancerous tissue of the neck, and I was obliged to resort again to the use of the vulsellum forceps.

With a view to limiting the operation to a supravaginal amputation if possible I cut off, with the curved scissors, the left half of the neck clear into the canal, and through the opening thus made introduced a finger into the uterine canal, where the exploration revealed irregularly nodulated and hard, tumefied portions of the mucous membrane, reaching up toward the fundus. I consequently abandoned the idea of supravaginal amputation, and proceeded at once with the total extirpation of the organ. As the first step in the attainment of this end I removed with a sharp spoon all the soft and decayed cancerous tissue of the ulcerated surface of the vaginal portion and the canal of the neck, so as to avoid septic infection from the side of the decayed tissue of the ulcerated surface when, later in the operation, it had to be inverted and turned into the peritoneal cavity. Next the anterior culdesac, that is, the vesico-uterine fossa, was opened by the scissors and the finger introduced into the peritoneal cavity. Using the finger as a guide, this opening was dilated outward on both sides by the scissors, keeping close to the body of the uterus until the anterior surface of the lateral ligaments was reached. The left index-finger was then pushed up and around the body of the uterus, which was found to be somewhat enlarged, but not adherent to any of the opposite surfaces of the peritoneum, and was, therefore, partly movable. The left hand was now withdrawn and the neck held up toward the symphysis pubis, by means of the vulsellum forceps, and the posterior culdesac opened in a similar manner, always keeping close to the body of the wound. The latter opening having been dilated laterally as far as the posterior surface of the lateral ligaments, the body of the uterus was anteverted by the left index-finger, and the vulsellum forceps attached to the tissue of the fundus, which was so soft as to tear asunder twice before I finally succeeded in drawing it down and out through the anterior culdesac into the vulva. The left index-finger was then hooked around the left lateral ligament, the fundus held over to the right by an assistant, an armed aneurism needle pushed through the right lateral ligament from the posterior to the anterior surface, and thus the ligament was ligated in two halves. A single peripheral ligature was applied around the entire lateral ligament just exterior to the double ligature, and then the lateral ligament was cut through at a point 1.5 cm. inside to the double ligature, between the latter and the uterus. The large branches of the uterine artery were not bleeding to any extent, but were, nevertheless, secured by separate silk ligatures, which were cut off short. The body of the uterus could now be drawn down outside of the vulva, and no difficulty was experienced in applying similar ligatures to the left lateral ligament. Thus the entire uterus was wholly detached and taken out through the vulva. The ligatures of the lateral ligaments were left with one end long enough to extend outside of the vagina.

Through the large opening in the peritoneum made by the removal of the uterus projected several portions of prolapsed intestine; namely, an ansa of the sigmoid flexure, two ansæ of the small intestine, and a portion of the omentum. The wound was washed out with a 2.5 per cent. solution of carbolic acid. The hemorrhage from the bleeding surfaces was not readily checked, but was finally controlled by two silk ligatures and the use of disinfected sponges. A disinfected sponge attached to a silk ligature was passed into the peritoneal cavity to retain in position the prolapsed intestines, and was allowed to remain until the wound in the bladder had been closed. The prolapsed mucous membrane of the latter was dark red in color, and presented a dotted appearance, as if numerous small ecchymoses had taken place therein. By means of sharp hooks the muscular coat of the bladder was seized, and the wound united by sutures of fine silk, which were passed through the muscular coat only, running between the latter and the mucous membrane for 0.5 cm. on each side. Eight of these sutures were required for the perfect closure of the wound in the bladder. All these sutures were cut off short, with the intention of leaving them in permanently.

The next step in the operation was the closure of the wound in the peritoneum. To this end the sponge was taken out of the peritoneal cavity, and the intestines carefully cleansed from the numerous small fibrinous clots upon them. The lateral ligaments were drawn down far enough, not only to permit the palpation, but also to inspect the surface of both of the ovaries, which were found perfectly healthy, and consequently were not disturbed. An armed needle was pushed through the vaginal mucous membrane at each lateral end of the wound in the posterior lacuna; pushed through the lateral ligament exterior to the ligatures, and then brought out through the mucous membrane of the anterior lacuna and tied, thus securing the central ends of the lateral ligaments, which were thus held down in the vagina and kept from slipping up into the peritoneal cavity. The anterior and posterior flaps of the peritoneum were seized with sharp hooks and united by fine silk sutures, of which 12 were necessary for the perfect closure of the wound. The sutures were all cut off short and left in permanently. The slight hemorrhage caused by the stitching together of the peritoneal wound soon ceased on irrigation with 2.5 per cent. solution of carbolic acid, and the patient was put to bed on a narrow cot having a hair mattress.

Mikulicz's instrument for permanent irrigation of the vagina was introduced, and fastened to a cincture around the abdomen. A lukewarm, 0.1 per cent. solution of thymol was used for the permanent irrigation. A flexible, soft-rubber catheter was inserted into the bladder and retained permanently. The peripheral end was held down in a vessel filled with 5 per cent. solution of carbolic acid.

The operation commenced at about 3 o'clock in the afternoon, and lasted two and one-half hours.

When the patient awoke from the narcosis at about 6 P. M. she was pale and weak, but did not complain of any pain, and did not look collapsed to any considerable extent. Pulse, 110; temperature, 99° F. 8 P. M.: Pulse, 120; temperature, 100° F.; respiration, 19. Rests quietly, and complains of no pain.

September 20th: 1 A. M.: Pulse, 120; temperature, 100.2° F. Has taken $\frac{1}{2}$ ounce of champagne with bits of ice. The extremities are cold; applied hot cans to the feet. 7.30 A. M.: Pulse, 120; temperature, 100.2° F. Has rested quietly, complains of no pain, but speaks in a whisper and appears weak. 2 P. M.: Pulse, 120; temperature, 101.2° F. Complains of pain in the abdomen, for which 15 drops of laudanum were given, which was vomited up half an hour afterward. She now took a tablespoonful of champagne with ice. 11 P. M.: Pulse, 120; temperature, 102° F. Complains of severe pain in the abdomen, for which 15 drops of laudanum were given.

September 21st: 1 A. M.: Pulse, 120; temperature, 101° F. The patient has vomited several times, and complains of severe pain in the abdomen, for which a hypodermic injection of $\frac{1}{4}$ grain of morphin was given. 8 A. M.: Pulse, 120; temperature, 101° F. Patient has rested since 1 A. M. As the pain in the abdomen had recurred, the hypodermic injection of morphin was repeated, and a pad of Lister's gauze dipped in hot carbolized water was applied over the abdomen. 4 P. M.: Pulse, 120; temperature, 102° F. She has taken small quantities of champagne and ice from time to time. The hypodermic injections of morphin quiet her for from four to five hours, but then have to be repeated as the pain recurs.

September 22d: 8 A. M.: Pulse, 120; temperature, 101° F. The patient passed a very restless night, but is quiet now. She sleeps for fifteen or twenty minutes only at a time. 9 A. M.: Pulse, 120; temperature, 101.5° F. She has taken half a cup of coffee, some milk, and champagne. Complains of burning sensation in the abdomen, but no pain. The urine passed through the permanent catheter contained a considerable deposit of pus, but was acid and of a normal odor. The bladder was washed out with a saturated solution of boric acid. There is some tympanites, but no particular tenderness of the wall of the abdomen. She has passed no flatus, but says she feels that the passage of flatus would relieve the burning pain in the abdomen. A soft-rubber catheter having three additional holes cut in its walls was then inserted into the rectum and left there permanently. 10 P. M.: Pulse, 120; temperature, 102.5° F. The patient has had some pain in the abdomen during the day, which has been relieved by hypodermic injections of morphin every four to six hours. A considerable quantity of flatus has escaped through the tube in the rectum, which has eased her greatly. She has taken from time to time small quantities of milk, coffee, and champagne. Twice she has experienced slight nausea, which was relieved by swallowing small pieces of ice. In the afternoon she became restless, uneasy, and hot, and was given a sponge-bath of tepid water and alcohol. Toward evening she became a little delirious at intervals, and complained of burning pain in the wound, and wanted the irrigating solution cold instead of warm, which request was complied with. On account of the rise in temperature, she was given 4 grains of quinin every four hours.

September 23d: 5 A. M.: Pulse, 120; temperature, 101.6° F. During the night the patient has slept at intervals for half an hour at a time. Complains of great pain in the abdomen; has a weary expression. Asked for beer, which was given to her in small quantities. Tympanites less than yesterday. No dull percussion anywhere along the ascending or descending colon. The vagina is very sensitive, the least movement of the irrigator causing her intense pain.

The cover of the irrigator is removed three times a day, in order to cleanse the apparatus of the débris of necrotic tissue and fibrinous clots of exudated matter that are too large to pass through the efferent tube of the apparatus.

The vulva and the vagina present some edematous swelling, and the mucous membrane of the latter protrudes through the holes in the inner half of the irrigator. These protrusions resemble globular polypi, and they, as well as the wound at the bottom of the apparatus, are covered with a soft, yellowish mass of fibrinous exudated matter looking like croupous membrane. The wound and the internal surface of the apparatus are cleaned as far as possible by means of salicylated cotton dipped in 5 per cent. solution of carbolic acid; the débris brought out by the cotton has a gangrenous odor.

The solution in the vessel into which the efferent tube of the apparatus discharges has a scarcely perceptible gangrenous odor, which is overcome in great measure by the odor of the thymol solution used for irrigation. 8 P. M.: Pulse, 120; temperature, 102° F. Has had less pain in the abdomen during the day; has taken considerable milk and champagne; has slept at intervals; complains of weakness.

September 24th: 8 A. M.: Pulse, 120; temperature, 101° F.; less pus in the urine than yesterday. When the bladder is washed out, after the injection of about 4 ounces of boric-acid solution, a portion escapes through the vagina. 12 NOON: Pulse, 115; temperature, 100° F. The patient has had half an hour of natural sleep, and is perspiring profusely. 2 P. M.: Pulse, 115; temperature, 101.5° F. Is sleeping and still perspiring freely. 4 P. M.: Pulse, 114; temperature, 101.7° F. Complains of no pain, but of weakness and itching of the upper part of the back, where, on examination, an acute diffused eczema was found, which had been caused by the constant wetting of the sheets by the irrigating fluid, of which a part passed into the bed between the vulva and the irrigator, as the efferent tube was not sufficiently large to allow the escape of the entire amount. 6.30 P. M.: Pulse, 100; temperature, 101.2° F. 10 P. M.: Pulse, 112; temperature, 101.2° F. Has had a fit of coughing which caused some difficulty in breathing. Owing to her weakness, the exertion required to cough up the mucous matter from the throat produced a cold perspiration over the entire body, with a feeling of extreme exhaustion and almost imperceptible voice. The extremities were bathed with hot water and alcohol and hot cans applied. Physical examination of the lungs showed normal percussion and respiration sounds, and no râles could be heard anywhere.

September 25th: 8 A. M.: Pulse, 104; temperature, 101° F.; respiration, 19. The patient rested well the remainder of the night, has no pain, partakes freely of champagne, beer, beef-tea, and coffee. She expectorates freely. The secretion from the wound is inodorous. The urine still contains pus. 10 A. M.: Pulse, 104; temperature, 101° F. 1 P. M.: Pulse, 104; temperature, 101° F. Says she feels well with the exception of pain in the sacral region from the bed-pan. 6 P. M.: Pulse, 104; temperature, 101.2° F. Is becoming restless and uneasy, but was relieved by a hypodermic injection of morphin.

September 26th: 8 A. M.: Pulse, 102; temperature, 101.5° F. The patient was restless until 1 o'clock this morning, but slept from 2 until 4. Since that time she has been somewhat restless, principally on account of a superficial bed-sore of about the size of a dime over the sacrum. The constant irrigating apparatus was removed with some difficulty, owing to the polypus-like protrusions of the vaginal mucous membrane through the holes in the irrigator. Two of the ligatures around the broad ligaments were found to be loose and were removed. The whole of the inner surface of the vagina was superficially eroded and partially covered with yellowish, adherent fibrinous matter. A double soft-rubber drainage-tube was now inserted, and retained in position by means of salicylated cotton covered with a layer of carbolized cosmolin. The patient was turned on the side and supported in this position by means of pillows. 12 NOON: Pulse, 110; temperature, 101.2° F. She is resting better after a sponge-bath. 7 P. M.: Pulse, 100; temperature, 101.2° F. She has taken during the day about 8 ounces of beef-tea, with the yolk of an egg, champagne, coffee, a little chicken broth, and some Seltzer water.

September 27th: 8 A. M.: Pulse, 100; temperature, 100.2° F. The patient has slept several hours at a time during the night; she complains of frequent desire to urinate. The urine contains a little pus. A pill of camphor, 2 grains; opium, 1 grain, was ordered morning and night. The discharge through the drainage-tubes has no offensive odor.

12 NOON: Pulse, 104; temperature, 100.6° F. 5 P. M.: Pulse, 98; temperature, 100.7° F. The patient sleeps for half an hour at a time and complains of no pain. 12 MIDNIGHT: Pulse, 100; temperature, 100.6° F. She feels somewhat weak, but complains only of pain in the calves of the legs, which was relieved by rubbing with alcohol.

September 28th: 9 A. M.: Pulse, 98; temperature, 100.2° F. The patient feels stronger and takes more food. 7.30 P. M.: Pulse, 100; temperature, 100.4° F. Has taken considerable liquid nourishment during the day: one egg, 8 ounces of chicken soup, some beef-tea, besides champagne and beer.

September 29th: 9 A. M.: Pulse, 96; temperature, 99.4° F. She has slept considerably Puring the night, and her only complaint is in regard to the small bed-sore over the sacrum. 6 P. M.: Pulse, 96; temperature, 100.8° F. Has had an annoying cough during the day, which causes some pain in the left iliac region, especially when she lies on the left side. Camphorated tincture of opium, mixed with syrup of orange-peel, 1 dram of each, was given every two or three hours. 12 MIDNIGHT: Pulse, 96; temperature, 100.2° F.

September 30th: 9 A. M.: Pulse, 98; temperature, 99.1° F. The patient passed a somewhat restless night, but has had no pain and no cough. 1 P. M.: Pulse, 100; temperature, 99.8° F. Complains of some pain on urinating through the permanent catheter. Otherwise she feels well and has a natural expression. She has taken today the first solid food since the operation: toast with her coffee in the morning, and a piece of fish and a little apple pudding at dinner. 6 P. M.: Pulse, 90; temperature, 99.6° F.

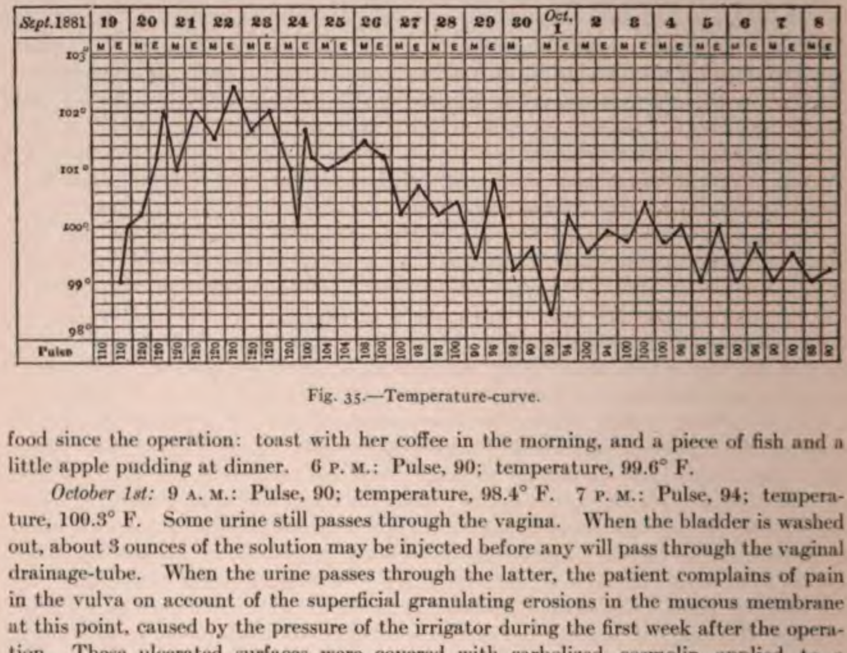

Fig. 35.—Temperature-curve.

October 1st: 9 A. M.: Pulse, 90; temperature, 98.4° F. 7 P. M.: Pulse, 94; temperature, 100.3° F. Some urine still passes through the vagina. When the bladder is washed out, about 3 ounces of the solution may be injected before any will pass through the vaginal drainage-tube. When the urine passes through the latter, the patient complains of pain in the vulva on account of the superficial granulating erosions in the mucous membrane at this point, caused by the pressure of the irrigator during the first week after the operation. These ulcerated surfaces were covered with carbolized cosmolin applied to a tampon of salicylated cotton and placed around the ends of the drainage-tube. The permanent catheter was removed.

October 2d: 10 A. M.: Pulse, 100; temperature, 99.5° F. 9 P. M.: Pulse, 94; temperature, 100° F.

October 3d: A. M.: Pulse, 100; temperature, 99.7° F. P. M.: Pulse, 100; temperature, 100.5° F.

October 4th: A. M.: Pulse, 100; temperature, 99.7° F. P. M.: Pulse, 96; temperature, 100° F.

October 5th: A. M.: Pulse, 96; temperature, 99° F. P. M.: Pulse, 96; temperature, 100° F.

October 6th: A. M.: Pulse, 90; temperature, 99° F. P. M.: Pulse, 96; temperature, 99.7° F. The patient's bowels, which had not moved since the operation, were moved today by an enema, and a very large quantity of feces was passed, after which she felt somewhat weak and a little sore in the lower part of the abdomen.

October 7th: A. M.: Pulse, 90; temperature, 99° F. P. M.: 90; temperature, 99.5° F.

October 8th: A. M.: Pulse, 85; temperature, 99° F. P. M.: Pulse, 90; temperature, 99.2° F. The patient has had a natural passage from the bowels; sleeps all night; has a fair appetite; can turn over on her side, and is feeling stronger.

October 11th: Pulse and temperature normal. The patient was taken out of bed and sat up in a reclining chair for a couple of hours. The quinin was discontinued, and two 2-grain iodid of iron pills ordered three times a day.

October 17th: Pulse and temperature normal. The patient is up and about all day long and gaining strength rapidly. When she walks, a little urine passes through the vagina, keeping her clothing wet all the time. At night there will be no passage of urine for about two hours, then the desire for micturition will set in suddenly, and before she can get the bed-pan, part of the urine will pass through the vagina. There is very little discharge through the drainage-tubes, which were removed. The nurse was instructed to wash out the vagina morning and night.

October 24th: The patient is up and about the house all day, and is feeling stronger every day. She states that she is feeling better than for the past five or six months, her anemic condition is disappearing, and some color is returning to her cheeks. The vesicovaginal fistula is closed, so that she has no discharge through the vagina at night. During the day she is obliged to urinate about every three hours, but all the urine passes through the urethra. The desire to urinate still comes on suddenly, and if she does not respond quickly, some of the urine will be passed through the urethra.

On examination of the vagina with a speculum it was seen that on the left side was a perfect linear cicatrix, but on the right side two of the ligatures around the broad ligament were still adherent, and offered so much resistance to the forceps that they were allowed to remain *in situ* a little longer. Lower down in the vagina were five pedunculated polypi, 1 cm. long and 0.5 cm. in breadth, which remained as reminiscences of the irrigating apparatus, as above mentioned.

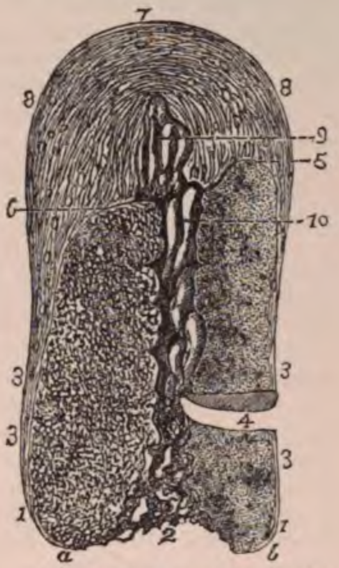

Fig. 36.—Anteroposterior section through the extirpated uterus: 1, Vaginal portion: *a*, anterior lip; *b*, posterior lip; 2, ulcerated external os; 3, cervix uteri; 4, cut through the neck, through which digital exploration revealed irregular cancerous masses in the cavity of the fundus; 5, limit of cancer in the posterior wall of the fundus; 6, limit of cancer in the anterior wall; 7, fundus of the uterus; 8, healthy wall of the somewhat enlarged fundus uteri; 9, dilated upper half of the cavity of the fundus uteri; 10, globular cancerous vegetations in the mucous membrane of the lower half of the cavity of the fundus uteri.

Examination of the extirpated uterus showed the following: The whole organ was 4½ inches long, the cavity 4 inches long. The cervix was considerably enlarged, being about 2 inches in diameter; the thickness of the wall at this place was more than ¾ inch. The external os and the whole of the cervical canal presented an irregularly ulcerated surface, and the thickened wall was seen to consist of white, carcinomatous tissue. The body was enlarged, 2½ inches broad, 1¾ inches in anteroposterior diameter, and 6¾ inches in circumference. The anterior wall was 1 inch thick, the posterior wall ¾ inch. The whole of the lower half of the cavity of the body was filled by an irregularly nodulated cancerous mass, covered with hypertrophied mucous membrane, as shown at 10, in Fig. 36. The cancerous mass infiltrated the wall of the body as high up as the tumor of the cavity extended, namely, involving the entire lower half of the anterior wall, and extending higher on the posterior wall, so as to involve the lower two-thirds of the latter.

Microscopic examination of the tumor showed the following: A section from the center of the infiltrated wall showed a stroma of connective tissue and organic muscular fibers infiltrated with numerous young lymphoid or connective-tissue cells. The stroma inclosed very large and irregular shaped cavities, some of which were lined with cylindric cells, and filled with large, multiform epithelial cells; others had no regular lining of cylindric cells, but contained large epithelial cells, mostly irregular in shape, but some of which approached the cylindric type, and others the pavement-cell type.

A section from the upper border of the tumor showed the large carcinomatous alveoli, defined by a rather sharp line, above which the uterine tissue showed the normal structure of organic muscular fibers, connective tissue, and vessels, not infiltrated with any proliferation of young cells.

Sections made at various points on the cut surfaces of the lateral ligaments showed neither alveoli with epithelial cells nor infiltration with leukocytes or young connective-tissue cells.

Consequently, the character of the tumor was found to be the following: An epithelial carcinoma of mixed cylindric-cell and pavement-cell types, leaning rather toward the character of the typical so-called epitheliomata than to medullary carcinomata. The sharp line of definition upward pointed to a relatively local, hence relatively benignant, character of the growth. The cylindric cells in the alveoli and the extension of the carcinoma high up in the cavity of the corpus showed its origin to have taken place in the mucous membrane of the cervix uteri. The absence of carcinomatous matter in the broad ligaments gave some reason for the hope that the whole of the carcinomatous tissue had been removed, which, taken in connection with the relatively benignant character of the tumor, led to the belief and hope that the reappearance of the tumor, either here or in the neighboring lymph-glands, might be deferred for a period corresponding to the good results obtained from the extirpation of epithelial carcinomata in other parts of the body, as, for instance, the lips and rectum.

As this operation is one of the latest of the steps forward in modern surgery, and cannot as yet be considered the common property of the profession, because it has not yet passed out of periodic literature, not even so far as into any monograph, I shall try, as far as the material at my command will permit me, to review the subject, considering, first: The indications for the operation; second, the operation itself; third, the after-treatment; fourth and finally, the results.

I. Indications for the Operation.—Malignant growths of the uterus have thus far been the only indications for the vaginal extirpation of that organ. Comparing the statistics of the abdominal with those of the vaginal operation, it is safe to say that whenever the total removal of the organ is indicated and this can be done through the vagina, that is, when the body of the organ is not enlarged to a very considerable extent, the latter method is preferable to the operation by abdominal section, for the following reasons:

(*a*) *The shock*, which we know to be a capital danger in any protracted operation combined with laparotomy, is so much less in the vaginal extirpation that Schröder has been generally acknowledged to be correct in his statement that a woman after the total extirpation of the uterus through the vagina resembles rather a puerpera after a considerable postpartum hemorrhage than a patient who has just experienced a very severe operation.

(*b*) *The ligation of the ureters*, and the accidental division of the ureters and opening of the bladder, can be almost, if not entirely, avoided in the vaginal extirpation by sufficient skill and care in the operation; while this dangerous and often fatal complication is likely to and in a number of cases has actually taken place during the abdominal operation, because the field of operation in this method is far from the surface—so far, indeed, that resection of the symphysis pubis has been proposed as a facilitating measure. Besides this, the separation of the organs in question from the uterus has to be effected in the dark, while in the vaginal extirpation this part of the field of operation is much more easily accessible.

(*c*) *The safe removal of all the carcinomatous tissue*, which, as most uterine carcinomata originate in or near the vaginal portion, and sometimes appear as isolated nodules involving the vaginal mucous membrane in one or both lacunæ, can be effected with almost entire certainty through the vagina only, where the whole of the field of operation is open to view; while by the abdominal operation the removal of the vaginal portion is performed entirely in the dark, guided only by the digital touch.

The character of the malignant growth which is to be extirpated through the vagina will, as above stated, be most frequently a carcinoma, more rarely a sarcoma, and, even more rarely, as in Czerny's case, an adenoma of the mucous membrane, originating in a fibromyxomyoma of the wall of the organ.

When one of these malignant growths has originated in the cervix and involves part of the fundus, or has originated in the fundus and extended from there to the neck, and the fundus is not enlarged above a size that will permit of a complete version of the organ through the anterior or posterior lacuna into the vagina, the operation is indicated. A large majority of uterine carcinomata commence in the vaginal portion, and will, when operated upon in time, permit a radical extirpation of all the diseased tissue by means of an operation much less dangerous—supravaginal amputation of the cervix uteri. Consequently, the total extirpation through the vagina will be required in cases of these carcinomata only when they have not been operated upon in time, that is, not until the carcinoma has extended above the internal os.

A uterine carcinoma seldom originates in the mucous membrane of the cervix. According to the laws of development of such carcinomata, the tumor will generally be a cylindric-cell carcinoma, and this form of cancer will be apt to reach far up into the cavity of the fundus at an early stage of the disease, before any considerable enlargement or ulceration of the vaginal portion has taken place. Consequently, carcinomata originating in the mucous membrane of the cervix will indicate, almost from the beginning of the disease, the total extirpation of the uterus through the vagina.

It may be difficult in a number of cases to decide, even after most minute preliminary examination, whether a uterine carcinoma involving the vaginal portion and the cervix can be removed satisfactorily by supravaginal amputation alone or by total extirpation of the organ. Practically, the decision is only of slight importance if we proceed in the following manner: Prepare for the total extirpation; commence the operation as if the removal of the cervix only were to be performed; then, if it is discovered that all the diseased tissue cannot be removed by this procedure, proceed at once to the total extirpation. This plan of procedure does not involve any loss of time, either to the patient or to the operating surgeon, because supravaginal amputation is the first step in the total extirpation through the vagina.

The sarcomata, which originate much more frequently in the fundus than in the cervix, will undoubtedly, in most cases, before the operation can be considered, have enlarged the fundus to such an extent as to make the extirpation per vaginam impracticable, thus limiting their extirpation to one of the abdominal operations.

But if a sarcoma of the uterus can be diagnosed in time to permit the removal of the organ through the vagina, this operation would not only be preferable, but would also be likely to give most satisfactory results as to permanent cure, since we know that uterine sarcomata are much less liable to involve the broad ligaments than carcinomata.

In the more rare forms of malignant growths, such as adenofibromata or adenosarcomata, the total extirpation of the uterus through the vagina is to be considered in the beginning of the disease, when the hemorrhages and relapses cannot be controlled by any other operative procedure. But, unfortunately, most myxomata, fibromyxomata, and fibromyomata cause too great enlargement of the fundus before the operation can be considered, and consequently require total abdominal extirpation or abdominal amputation of the cervix. Adenomata also will generally permit of the removal of the involved tissues by scraping out with the sharp spoon or by cauterization with the galvanocautery. But still Czerny's case stands as an example of the possible indication of the operation in this variety of tumors.

As contraindications to the total extirpation through the vagina we may mention considerable involvement of the broad ligaments, bladder, or rectum by the cancer, and the palpable infiltration of the deep-seated lymph-glands along the border of the pelvis minor, and, finally, very limited mobility of the uterus. If it is found on exploration that the uterus cannot be moved up and down almost as easily as when in its normal condition, but is attached to the walls of the pelvis minor or to the organs situated behind it, the operation may have to be abandoned, because it is a *conditio sine qua non* for its practicability that the vaginal portion can be drawn down almost into the vulva or very near to the end of the vagina. Too violent traction may cause rupture of adhesions or of the broad ligament, with subsequent hemorrhage from vessels situated so high up in the abdominal cavity as to be entirely inaccessible for surgical control through the vagina.

II. The Operation.—A few preparatory measures before the operation may be indicated. If the patient has a fetid carcinomatous ulcer of the vaginal portion or of the external os, we naturally desire to have the mucous membrane of the vagina disinfected as far as possible before leaving this cavity in open communication with the pelvic cellular tissue, or even the peritoneal cavity. To this end it has been advised that the entire decayed wall of the cancerous ulcer be scraped out with the sharp spoon as a preparatory procedure five to eight days before the operation; and then that the vagina be washed out two or three times daily with a 2 or 3 per cent. solution of carbolic acid. After each injection the vagina should be filled up with salicylated absorbent cotton to take up any fetid matter which may be excreted from the tumor. During this period it is advisable to give only liquid food to the patient, and to administer mild cathartics sufficient to produce daily alvine discharges, with a view to having the bowels empty at the time of the operation, that alvine discharges may not occur during the first week or two of the after-treatment.

Six reliable assistants are required in performing the extirpation. The patient is deeply anesthetized and placed on a table in the lithotomy position. Good light—I should always prefer sunlight—upon the field of operation is very necessary. The vagina is first washed out with a 5 per cent. solution of carbolic acid; the hairs on the mons veneris and perineum carefully shaved off, and the skin around the vulva cleaned and disinfected by means of soap, nail-brush, and 3 to 5 per cent. solution of carbolic acid. The spray is not employed, as it is unnecessary and troublesome; but the field of the operation is constantly irrigated by a 2 to 3 per cent. solution of carbolic acid, either by an irrigator or, what I consider preferable, by disinfected sponges.

An assistant on each side holds a femur of the patient, and also a Simon's speculum for dilatation of the vulva. The blade of the speculum should be a little longer than usual; that is, 2½ to 3 inches instead of the ordinary length, 2 inches, and somewhat concave laterally, so as to fit against the pubic arch, with a view to the dilatation of the vagina to its utmost extent.

If the entrance to the vagina should be too narrow, as may be the case in nulliparæ, the perineum should be divided in the median line. This wound may, at the close of the operation, be united by a simple perineorrhaphy.

If it is discovered later in the operation that any part of the vagina is too narrow, it may be enlarged with a knife in the lateral regions, so that the bladder and rectum may not be accidentally opened.

The vagina having thus been sufficiently dilated by means of Simon's specula held against the anterior and posterior wall, the vaginal portion of the uterus is now seized by a strong vulsellum forceps and drawn down as far as possible toward the vulva. In the majority of cases the cancerous tissue which is seized by the forceps is so soft and friable that the wound is carefully closed, and the after-treatment conducted with reference to this complication. I shall return later on to the further consideration of this point.

(*b*) *The Opening of the Posterior Culdesac.*—When the uterus has been drawn upward toward the symphysis pubis, one or two fingers should be introduced through the anterior culdesac, hooked around the fundus, and passed down into Douglas' culdesac, and the opening of the latter easily effected on the point of the finger as a guide. The opening thus made is dilated outward toward the lateral ligaments, in the same way as this was accomplished in the anterior culdesac. In passing the fingers around the fundus we may sometimes meet with adhesions between the latter and the surrounding peritoneal wall. Such adhesions should be separated, if possible, by the finger-nails as close to the uterus as possible. Too firm, heavy, and extensive adhesions may necessitate the abandonment of the operation at this point (Martin), as too forcible traction would be liable to tear off large portions of the parietal peritoneum, torn vessels in which might cause hemorrhage into the peritoneal cavity at a point too high up to permit the bleeding vessels to be caught up and ligated from the vagina.

The fundus of the uterus is now adherent only by or suspended in the lateral ligaments; but before we can seize these, we will have to proceed with the next step in the operation:

The Eversion of the Fundus Uteri.—It is necessary to seize the fundus and draw it down into the vulva before the lateral ligaments can be brought into the field of operation. The eversion may in many cases be accomplished by combined manipulation with the index-finger of each hand, without any particular difficulty. But in some cases, when, for instance, the fundus is somewhat enlarged or the lateral ligaments short and tense, it may prove a rather troublesome step in the operation. Sharp hooks or the vulsellum forceps, introduced through the vesico-uterine fossa and seizing the fundus uteri, which has been pressed forward by the index-finger of the left hand in Douglas' fossa, will usually be sufficient to bring the fundus down through the vesico-uterine fossa into the vagina. But in a number of cases the tissue of the fundus is soft, and these instruments will tear through. As the operation itself is so difficult and the time occupied in its performance so great, any suggestions by which the duration of any of the steps of the operation may be shortened and the operation facilitated should be accepted with gratitude.

Martin, who has several times met with difficulty in the eversion of the uterus, has devised* an instrument of about the shape and size of the urethral sound, the end of which is enlarged into an oblong, oval body, or, as he describes it, "pear-shaped." The circumference of the end is 4 cm., and the whole instrument 33 cm. long. He pushes the pear-shaped end of this instrument into the uterine canal, holding the handle and shaft up against the symphysis pubis. On bringing the shaft down toward the rectum the fundus uteri can be pushed upward against the concave surface of a Sims' speculum, and be made to slide out far enough along this to be seized in the anterior lacuna. A loop of heavy silk thread is now passed through the fundus, the ends knotted, so that by it the fundus may be drawn down or moved in any desired direction during the next step of the operation:

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* Centralbl. f. Gynäkologie, 1881, vol. v, p. 99.

The Separation of the Uterus from the Lateral Ligaments.—The main point to have in view during this stage of the operation is to effect perfect security for immediate, and especially for secondary, hemorrhage from the large vessels supplying the uterus. This may be effected in two ways—(*a*) By the separate ligation of every bleeding vessel as soon as opened (Czerny, Hofmeier); or (*b*) by ligating the lateral ligaments *en masse* (Billroth, Mikulicz, Schröder). The future must decide which of these methods is preferable—each of them has its decided advantages.

(*a*) *The gradual division and successive ligation of all vessels* is the most rational, on general surgical principles, and possesses the two following advantages: First, it permits us to inspect the entire cut surface of the ligaments, and ascertain if any cancerous tissue has been left *in situ*. If this has been done, it permits us, by means of blunt instruments, as, for instance, two dissecting forceps, to excavate and remove any spots of cancerous tissue, cancerous infiltrated lymph-ducts and lymph-glands, as far as the exterior wall of the pelvis minor. This may be done with the same security and in exactly the same way in which the similar operation for the removal of cancerous lymph-glands in the axilla, after the removal of a cancerous mammary gland, is performed. Second, it has the advantage of not leaving any part of the lateral ligament to slough, as does the ligature *en masse*, and, consequently, there is no risk of leaving decomposing tissue in or inside of the peritoneal wound.

This procedure has the following disadvantages, which, of course, are identical with the advantages of the other method, namely, that it takes a longer time and is less secure as regards the stopping of hemorrhage.

(*b*) *Ligature en masse.*—I feel inclined, with Billroth, Mikulicz, and Schröder, to consider the ligature *en masse* as the safest and most easily accomplished. The way to proceed therewith is as follows: Pass a heavy silk thread round the entire ligament, and ligate as far out toward the lateral wall of the pelvis as possible. Insert, just at the medial side of this ligature, through the midst of the lateral ligament, a double heavy silk thread by means of a pointed, curved aneurism needle, and thus ligate the ligament in two portions. Leave one of the ends of these ligatures long enough to extend outside of the vagina. As the lateral ligaments are often rather voluminous, and the slipping of the ligatures would be a very undesirable accident, Billroth's avoidance of this by the following device is noteworthy. Before applying the ligatures around the lateral ligament he seizes the latter, through its entire thickness, with a strong forceps having two long and narrow branches, made especially for this purpose, and closing the forceps forcibly he makes, by means of its branches, a depression, furrow, or sulcus in the ligament, exactly the same effect as is produced in the pedicle of ovarian tumors by means of the common temporary clamp. In this furrow he applies the ligature *en masse* after the removal of the forceps. A second furrow is made for the double reserve ligature in two portions.

When, thus, the lateral ligament is securely ligated, the long ends of the ligatures are run downward and outward, the uterus drawn inward toward the median line, and the central portion of the lateral ligament divided at about 1 cm. from the ligature. For further security against hemorrhage the larger vessels met with may be ligated separately with catgut or silk.

One of the lateral ligaments having thus been divided, it is easy to draw the fundus uteri down into the vulva, and then not only explore with the finger, but even inspect with the eye, the ovaries and the whole of the lateral ligaments. If any of these parts are involved with cancer or otherwise degenerated, the question of their removal naturally presents itself. As far as I know, this has not yet been performed successfully, but in cases of need, where the diseased parts in question are sufficiently movable to permit of their being brought down into the field of operation, ligatures can be passed around their peripheral attachments, and they themselves removed (Schröder). The second lateral ligament is easily ligated, in the same manner as above described, the uterus separated entirely and taken out through the vulva.

Treatment of the Peritoneal and Vaginal Wounds.—It is as yet an open question whether the wound in the peritoneum shall be left open or carefully united. To me it seems decidedly the most rational procedure to unite the whole of the peritoneal wound as carefully as possible (Czerny, Martin). To this end I proceed in the following manner:

A heavy silk ligature is pushed in through the mucous membrane of the posterior lacuna, near the lateral corner of the vaginal wound; passed through the midst of the ligated lateral ligament, just outside of the ligature, and brought out through the mucous membrane of the anterior lacuna. When this ligature is tied, it serves to draw the peripheral end of the lateral ligaments down into the vagina, or at any rate into the vaginal wound, with a view of keeping the sloughing central portions of the lateral ligaments out of the peritoneal cavity.

After having carefully cleaned the prolapsing intestines with disinfected sponges, some of which are allowed to remain for a short time between the intestines and the upper part of Douglas' fossa, I take hold of the edges of the peritoneum with sharp hooks, draw them down and toward each other, and unite them carefully with fine sutures of disinfected silk, distant about 0.5 cm. from each other, commencing in the median line, so as to be hindered less by the prolapsing intestines, and continuing from this point outward on each side until the last suture is closed to or through the peritoneal surface of the lateral ligament, which had previously been drawn down.

If the bladder or rectum has been opened by accident or intention, these openings are carefully united by a sufficient number of fine silk sutures, taking care to have these passing through the muscular walls of these organs alone, and not involving the mucous membrane. All these sutures are cut off short and left in permanently.

Some operators (Billroth, Mikulicz, Schröder) do not unite the wound in the peritoneum. Schröder leaves it as it is and inserts a heavy drainage-tube, terminating in a transverse portion, the ends of which rest upon the upper inner surface of the ligated lateral ligament. The vaginal portion of this tube is kept firmly in place by means of salicylated cotton wound around it.

Billroth and Mikulicz pass, through the edges of both flaps of the peritoneal wound, silk threads, two or three on each side. These are knotted, and when traction is made upon them, draw the edges of the wound together so that it resembles the mouth of a tobacco-pouch. The latter procedure of Billroth and Mikulicz is resorted to, not with a view to using drainage-tubes, but rather with a view to employing permanent irrigation in all cases. To the external opening of their irrigator are attached the ends of all the silk threads, both from the peritoneal wound and from the lateral ligaments. That this latter procedure does not present any absolute security against invasion of the peritoneal cavity by liquid or micrococci from the vagina is obvious, and in cases like my own, in which the bladder was opened, I should certainly trust nothing but a most minute closure of the peritoneal wound.

Before considering the after-treatment, I shall only say about the operation that even under the most favorable circumstances it is a long and difficult one. The space that is left for the field of operation is small. The applicance of sutures and ligation of vessels have, as a general rule, to be done 1 or 2 inches internal to the vulva. The working space in the vagina may be increased somewhat by the use of a Simon's speculum, applied in each lateral wall of the cavity. No considerable hemorrhage has been reported in any of the cases on record, still the compression of the abdominal aorta may, in case of need, be of great value.

In less favorable cases, in which, on account of adhesions or for some other reason, the uterus is not very movable; the walls of the vagina more rigid; the bladder or rectum opened; the operation certainly deserves, as Martin says, "to be classed as one of the most difficult operative procedures in abdominal surgery."

Possible Mishaps During the Operation.—We have already mentioned the opening of the bladder and rectum and shown that this may be sometimes necessary, so that these should not be counted among the mishaps, strictly speaking, and the treatment of such openings by careful union has been also mentioned.

The division of one or both of the ureters might be among the possibilities, though I do not know that it has happened in any of the cases on record. The only way to obviate the ill consequences of such a division, that is, evacuation of urine from the ureter into the peritoneal cavity, would be to seize the upper end of the divided ureter, pass a loop through its wall, draw it down into the vagina, and fix it there by means of sutures. When this is carried out effectually, I do not think that the mishap would necessarily endanger the patient's life, as the wound would heal up, and only a ureterovaginal fistula would remain.

The involving of one of the ureters in the ligation *en masse* of the lateral ligament should, of course, be studiously avoided. If, however, the operator exercises due care, there is hardly any risk of this most dangerous, not to say fatal, complication.

The accidental opening of the intestines prolapsing from or tied down into the vesico-uterine or Douglas' fossæ by old adhesions is within the more remote possibilities. Undesirable as such an accident would be, it might not be necessarily fatal if a perfect union with catgut or, better, fine aseptic silk sutures is carefully effected, according to the well-known laws for operations upon the intestines.

Hemorrhage from torn vessels situated too high up in the pelvic cavity to permit of effective ligation may, as above stated, prove fatal, but this, we are happy to say, is rarely met with.

III. After-treatment.—The main and predominant question in the after-treatment is the question of drainage, combined or, we might say, identical with that form of the antiseptic method or antiseptic precautions which will prove the most effectual in keeping inflammation or infection away from the wound and the surrounding tissues and cavities. In considering this question we must take into account the merits and demerits of drainage-tubes and the washing out of the vagina through these, on the one hand, and permanent irrigation, on the other.

(*a*) *Drainage-tubes.*—A heavy drainage-tube with a transverse T-shaped portion resting in the ununited peritoneal and vaginal wound, and retained in position by salicylated cotton wound around it, is employed by Schröder. He makes injections of disinfectant solutions only when rise in temperature or fetid smell of the discharges calls for it. His brilliant success with this operation is a strong argument in favor of his method of treatment, in spite of any *a priori* objections that might be made about not uniting the peritoneal wound and the infrequent washing out of the drainage-tube. Martin makes use of drainage-tubes only for the drainage of the vaginal wound, as he recommends a careful union of the peritoneal wound.

The use of drainage-tubes has the great advantage that it incommodes the patient very little in the after-treatment as compared with the permanent irrigator. But it is still an open question whether sufficient disinfection can always be effected by them in cases where the bladder or rectum has been opened. In one of Czerny's cases, in which the bladder was opened, the peritoneal wound was united, drainage-tubes inserted, and the patient recovered. In Billroth's case, No. 4, in which the bladder was opened and united by sutures and the patient died from septic peritonitis thirty hours after the operation, drainage-tubes were employed in the ununited peritoneal wound, according to Schröder's method.

(*b*) *Constant Irrigation.*—Two fatal cases of Billroth's, in which peritonitis occurred notwithstanding the use of drainage-tubes, led Mikulicz to consider permanent irrigation as a method permitting more nearly perfect disinfection, and thereby promising the avoidance of fatal septic inflammations, namely, septic peritonitis and phlegmonous inflammation of the cellular tissue of the pelvis.

In some of the fatal cases in which drainage of the peritoneal cavity had been employed the postmortem examination showed that this drainage had been frustrated by the pliable walls of the intestines, and still more mobile and pliable omentum, which had occluded the openings in the drainage-tubes, above which large accumulations of septic fluid had formed. On this account Mikulicz came to the conclusion that it was impossible, by any method known up to the present time, to make effective drainage of the peritoneal cavity. From an *a priori* pathologic-anatomic point of view, I shall most certainly agree with him in this respect; but there is always some dissension between *a priori* reasonings and facts, as the statistics have shown that Bardenheuer's drainage through the vagina is a valuable factor in making Freund's operation, that is, the abdominal method of total extirpation of the uterus, considerably less fatal.

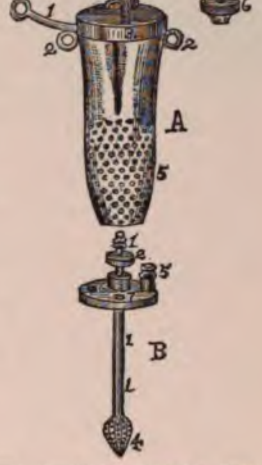

Fig. 37.—Vaginal irrigator (half of natural size).

A, Speculum (lateral view): 1, Handle, through the ring of which any cylindric body, for instance, a vaginal dressing forceps, can be pushed for getting a firm hold; 2, 2, rings for the bands for attachment of the apparatus to abdominal cincture; 3, 3, lateral screws to fasten the cover; 4, small spring for attachment of long ends of ligatures around the broad ligaments; 5, small holes through the internal half of speculum; 6, nut.

B, Cover: 1, Afferent tube with 2, screw; 3, stopcock, and 4, terminal bulb with small openings 5, efferent tube; 6, openings for overflow tube; 7, hole for lateral screw.

Note.—The cover does not fit tightly to the speculum, but is made air-tight by means of rubber washers.

It occurred to me that permanent irrigation would be the safest method in my case in which the bladder had been opened, and I consequently used a permanent irrigator, made exactly after the pattern of Mikulicz's, as shown in the cut in his above-mentioned paper.*

As I found in the course of the after-treatment some inconveniences of minor importance attendant upon the use of Mikulicz's irrigator, I shall here, for the sake of brevity, describe the modified instrument I propose to use. As shown in Fig. 37, it consists of a cylindric vaginal speculum, the central end of which is compressed and flattened so as to terminate not in a circular, but in an oval opening, the transverse diameter of which is the longer, and of the same length as the diameter of the tube. The internal half of the speculum is perforated by a large number of small holes cut close to one another. Mikulicz's irrigator has a small number of large holes, through which the edematous mucous membrane of the vagina protruded a few days after the operation, forming polypi, which not only made every movement of the instrument painful, but made its removal extremely difficult. At the outer end of this speculum, at its upper and lower aspect, in the median line, are rings through which bands are passed which are attached to a cincture around the abdomen, for the purpose of retaining the instrument in position. At the free borafter the most careful closure of openings into these organs, that the wounds will unite by first intention. We know, from a number of cases on record in which openings in the intestines have been united with sutures, that escape of some fecal matter has frequently taken place, for a short time, even in favorable cases. We know, further, that, after the *sectio alta* of the bladder, when performed with the most strenuous antiseptic precautions, in most cases a small quantity of urine escapes through the wound for a short time, followed by spontaneous closure of the small openings in the wound which had not united by first intention. Exactly the same imperfect union of the wound in the bladder by first intention occurred in my case as has been shown in the history. The small fistula closed spontaneously in a little more than four weeks after the operation.

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* Wien. med. Wochenschr., 1881, vol. xxvi, p. 96.

With these facts in view, it seems to me natural in such cases not to trust to drainage-tubes, with only periodic removal of the fluids and substances in and around the wound, but rather that constant irrigation is the only rational way to effect the removal of any urinary or fecal matter.

The opening of the bladder renders necessary certain special measures besides the treatment already mentioned. The main feature is the retention of a permanent catheter in the bladder. Without going too fully into details, I shall simply state that I have found the use of a soft catheter to be the most convenient. In the avoidance of irritation and subsequent cystitis by this procedure I consider the following factors of great value: First, the washing out of the bladder once or twice daily with a lukewarm saturated solution of boric acid. Second: the end of the catheter terminating directly or indirectly through a tube in a vessel filled with 5 per cent. solution of carbolic acid, by means of which only disinfected air can come in contact with the column of urine from the bladder. By careful attention to these precautions I have been enabled in this, as well as in other operations, perineal section, for example, to retain the permanent catheter in the bladder for more than two weeks without causing any irritation sufficient to necessitate its removal. Where the urethra is healthy, as in cases of extirpation of the uterus, I remove the catheter twice a day, in order to cleanse it by the use of 5 per cent. carbolic acid solution.

A permanent tube in the rectum—a large, soft-rubber tube with several holes cut in the sides—is of great help in the facilitation of the passage of the intestinal gases. It is needless to say that any accumulation of the latter, in cases of abdominal operations, causes great pain to the patient, which is speedily relieved by their escape. This tube should be taken out and cleaned every one or two days, as the mucous matter of the rectum becomes very tenacious, and will adhere to the tube and occlude the holes if not frequently removed.

As to passages from the bowels: It is natural that we desire to keep the bowels perfectly quiet until the peritoneal wound is entirely united. In common, uncomplicated cases, the bowels have been moved a week after the operation without inconvenience. In my own case I did not dare or wish to have the bowels moved until very late in the after-treatment, on account of the opening into the bladder, with a view to not disturbing the healing of the latter if it could be avoided. As the history shows, I had no difficulty in postponing the movement of the bowels until even sixteen days after the operation, notwithstanding that the patient took considerable liquid food during the whole of the time, and, toward the latter part, even small quantities of solid food.

As for the medical treatment after the operation, I have very little to say in addition to what is already known from other abdominal operations. To keep the patient free from pain and restlessness I use hypodermic injections of $\frac{1}{6}$ to $\frac{1}{4}$ grain of morphin; moderate doses of quinin when a rise in temperature occurs; camphor and opium pills for the tenesmus and pain in the bladder; bismuth subnitrate, with or without morphin, for pain in the cardiac region; and iced champagne and bits of ice for nausea.

The ligatures around the lateral ligaments will generally loosen and come off in the course of two or three weeks; sometimes one or more of them will remain for five or six weeks, as happened on one side in my own case. Inconveniences of this kind we may desire to avoid, and, consequently, in cases in which the lateral ligaments are long enough, we should avoid the ligature *en masse* entirely. Local granulating nodules, especially in the lateral portions of the wound, may remain for a considerable time after operation. These may easily be made to heal by superficial cauterization with nitrate of silver, tincture of iodin, or similar agents.

If the course of the after-treatment is favorable, the patient will be able to be out of bed in three weeks, and up and around the house in four or five weeks. It is needless to state that, during the convalescence, iron, wine, and food of the most nourishing character should be given to those patients who are anemic from constant loss of blood for months previous to operation; under this treatment the patients will gain strength rapidly.

IV. Results and Remarks.—We must naturally ask ourselves: Does suffering humanity gain anything by this operation? or, in other words, Does the operation enable us to save, or only to prolong, life, and is it worth while for patients having uterine cancer to undergo this severe operation?

By total extirpation of the uterus we desire to gain something more than the mere cessation of fetor and hemorrhage from the vagina, because we can obtain this by partial and very much less dangerous operations. We want to obtain perfect recovery, if possible, or, at any rate, health for some years, to compensate for the serious operation.

In making a total extirpation of the uterus for cancer we have the right to expect nothing more and nothing less than from the extirpation of cancer in other portions of the body. The immunity of the patient from a relapse of the cancer depends partly upon the anatomicophysiologic characteristics of the malignant growth, and partly upon the successful removal of all the diseased tissue by the operation. From the statistics of the cases operated upon we learn that in about 50 per cent.

of the cases relapse of the cancer set in *in loco* within a few months after the operation, and in regard to the remainder—the successful operations—the period since the operations had been too short to admit of our learning anything about definite cure. We do not need to be reminded, however, that the removal of malignant tumors in almost any part of the body except the ovaries is, and has always been, regarded as a procedure which the surgeon undertakes rather as a kind of traditional duty, than from any hope of thereby gaining for the patient radical cure or even, in all cases, a longer lease of healthy life.

The prospects for patients operated upon for cancer we have always considered very gloomy. We did not know the exact numeric expression of what benefit we might expect to derive from the extirpation of cancers until the recent statistics of Winiwarter, from the material of Billroth, at Vienna; Oldekop, from Esmarch's material at Kiel, and Henry, from Fischer's material at Berlin, threw some light upon the subject. The extirpation of cancers of the mammary gland gave a permanent cure in 9 per cent. of the cases. The statistics of 29 cases of cancer of the tongue, pharynx, and rectum reported by Kocher gave 31 per cent. of radical cures.

Mikulicz is certainly right in expressing the hope, or rather the justifiable expectation, that modern surgery will enable us to ameliorate the statistics of the radical treatment of cancer, for the following reasons: We have now the right, aided by antiseptic surgery, to operate much more extensively; to have, I may say, no apprehensions as to the size, location, and extent of the wound inflicted, within the limits for operations on vital organs established by anatomy and physiology, the transgression of which would cause immediate death. In other words, we need not care how near we come to vessels or nerves or the intestines, because we need be no longer afraid of endangering our patient's lives by secondary inflammations in such important organs, since it is in our power to prevent any and all such complications by sufficient skill and care.

We may consequently, in operating for cancer, do justice to one of the imperative conditions recognized from the olden time to be all-important, namely, the removal of every particle of diseased tissue, and expect in years to come to have a much larger proportion of permanent cures after the extirpation of cancers.

Now let us see how this applies to the total extirpation of the uterus through the vagina. If this operation were, or might be in the future, made as safe as ovariotomy now is in the hands of the best operators, or, as might not unreasonably be expected, almost as safe as the supravaginal amputation, we might then be justified in preferring the former to the latter method for the more effectual removal of all the diseased tissue. The vaginal extirpation, for instance, enables us to remove the spread nodules and infiltrated lymph-glands from the broad ligaments and the pelvic cellular tissue. But the operation has not yet reached such a degree of perfection and consequent safety that we are justified in substituting it for the less dangerous supravaginal amputation, and so much the more as the latter counts among its results some cases of permanent recovery, besides the numerous cases in which the patient's condition was sufficiently ameliorated to give her a longer period of happy existence in her family, enabling her, for a time, to resume domestic duties.

On the other hand, the material existing, and the results so far obtained, have won for this operation a higher position than that accorded to it by John Erichsen in his address before the Surgical Section of the International Medical Congress,* in which he chooses to designate such operations as "surgical triumphs or operative audacities, applied to the diagnosis or cure of diseases, in which but little of ultimate advantage and, certainly, much of immediate peril, may be expected from operative interference."

In natural science we have no right to expect anything good or bad without asking nature the right questions in the right terms. What the final answer to the question asked regarding the vaginal extirpation of the uterus for the cure of cancer will be we do not know. But with sufficient skill and in careful hands this operation does not involve an amount of unavoidable danger considerable enough to prevent us from being justified in resorting to it when indicated in a disease which we know to be necessarily fatal, and with full confidence in our ability to make the method of operation still more nearly perfect, and so lessen its dangers—a result which can be obtained, not by sterile *a priori* reasonings as to the right of its existence, but only by an earnest and impartial trial.

* Lancet, 1881, vol. ii, p. 227.

SUPPOSED POISONING BY BROMID OF POTASSIUM *

AN AUTOPSY LECTURE DELIVERED AT COOK COUNTY HOSPITAL, DECEMBER 5, 1881

THE history of the dead body before us is the following:

The patient, Mrs. Murphy, was a woman of about fifty years of age. No reliable history of previous life and health could be obtained. Her statements were inconsistent and unreliable. A fair history of epilepsia gravior could, however, be made out. Seizures occurred about once a month. Patient was known to be insane. She was discharged by the house physician to County Poor House, but through neglect of the nurse remained, and, December 1st, the attending physician ordered:

℞. Potassii bromidi............................℥j
Aquæ..................................ad ℥iv
M. SIG.—One dram every two hours.

December 2d: By an oversight no medicine was given yesterday. Had 1 dram of above prescription at 12 M., another at 2 P. M., and another at 5 P. M.

December 3d: 9.30 A. M.: Discovered patient in a stupor. Can be partially roused by irritation, but immediately relapses into a condition of stupor when the irritation is discontinued. When the integument of limbs is pinched, she draws up the limbs but does not speak. She sat up in bed, and was gotten into a chair for a short time. Drank part of a glass of milk. Slight jactitation of hands, pupils equal and normal in size, only slightly responsive to light. Pulse, 64, irregular and feeble; temperature, 98.1° F.; respiration, 20. On making inquiries as to the cause of this condition of affairs it was ascertained that about fifteen hours prior to this time patient had drunk the contents of the bottle containing the bromid of potassium solution prescribed for her, which had been left on the table beside her bed. Nine drams remained in the bottle, and this, with the 3 drams given by the nurse, left a balance of 1½ ounces, representing 300 grains of bromid of potassium taken by patient at one time.

Unfortunately, the nurse did not comprehend the situation, and no one was notified of the mishap. Patient continued in stupor, without convulsions or paralysis, until 10.30 P. M., when she died, twenty-eight and one-half hours after taking the potassium bromid.

Note Made by Dr. Bridge.—At 6 P. M. took her 300 grains of potassium bromid. Soon went to sleep, and slept until 9 P. M., when she began to be delirious and walked about. Had to be tied in bed about 4 A. M., about which time or soon after stupor commenced.

Antemortem diagnosis in this case was poisoning by an overdose of potassium bromid, of which as much as 300 grains, that is, 5 drams or 20 grams, had been taken at one time.

As I do not know, from the literature, of any case of death caused by an overdose of potassium bromid, the case before us today is of very considerable interest, and I propose to make an especially careful and thorough examination of the body.

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* Chicago Med. Review, 1882, vol. v, p. 40.

Before proceeding with this I will briefly state what toxicology teaches us about the effects of overdoses of potassium bromid, in order to compare these with the symptoms of the case under consideration. A dose of from 6 to 10 grams will cause transient headache, pressure in the temporal regions, slow and difficult speech, and delirium, which persist for, but disappear after, about twenty-four hours. After a dose of 15 grams, the following additional symptoms are noticed: The pulse decreases to 40; the heart-beat becomes irregular, and the bodily temperature is lowered 1.1° F. below normal—that is, to 97.2° F.

In rabbits a dose of 4 grams, administered either subcutaneously or by the stomach, causes collapse, cessation of motion and sensation, and in from fifteen to forty minutes death occurs, with symptoms of paralysis of the heart. A dose of 2 grams occasions nearly the same train of symptoms, which, after two or three days, terminate either in recovery or death, immediately preceded by dyspnea and convulsions.

The action of potassium bromid on the heart has been studied only in frogs. After the subcutaneous injection of 1 or 2 grains, that is, 6 to 10 decigrams of the salt, the following phenomena have been noticed on the denuded heart: Contractions of the auricles continue regular and rhythmic for a long time, while the contractions of the ventricles become slow and weak, so that, in the time occupied by two or three contractions of the auricles, there is only one contraction of the ventricles, and this is superficial and incomplete. In consequence of this we may expect to find a slow and weak arterial pulse. Finally, the contractions of the heart cease entirely.

When we compare these facts with the history of the case before us, we find that the irregular and feeble pulse of 60, and the decrease in temperature of four-tenths of one degree, are in conformity with the symptoms of an overdose of bromid of potassium. Besides this, the condition of sopor or stupor, noted December 3d, agrees with the symptoms we would expect to find. But the symptoms noted by Dr. Bridge, that the night after the supposed overdose of potassium bromid the patient got out of bed, walked about, and became so unmanageable that she had to be tied to her bed early in the morning, are greatly at variance with the main symptoms of potassium bromid poisoning, as a patient with general paralysis and anesthesia will not, as a general rule, be able even to get out of bed.

What we may expect to find in the body, if the diagnosis of potassium bromid poisoning is correct, cannot be definitely stated, as no case of the kind is yet on record. But, approximately, we may expect to find the same conditions as after poisoning by other salts of potassium. These may be briefly stated as follows: Liquid, dark-colored, non-coagulated blood, flabby, uncontracted heart, the walls of which present a little cloudy swelling. Aside from this, all the organs of the body should be perfectly healthy in appearance.

Autopsy made forty hours after death. Body well nourished. No edema; rigor mortis. Inside right elbow-joint and posterior part of extremities and trunk find the usual bluish-red spots of cadaverous discoloration. Pupils moderately dilated and equal in size. Adipose subcutaneous tissue of medium thickness and normal appearance. Transverse muscles somewhat pale and dry, otherwise of normal appearance.

Thorax: Pericardial sac contains ½ ounce of clear serous fluid, normal in appearance. Heart of normal shape and size. Both ventricles flabby. Right ventricle does not contain a trace of coagulum. All the blood is in liquid condition. The same is true of left ventricle and the auricles. Pericardium natural. Endocardium and valves normal. Left ventricle contains a little liquid blood of bright-red, arterial color. Blood from venæ cavæ is liquid and dirty, dark-brownish red in color.

Lungs: Left pleural cavity contains a little clear serous fluid. Left parietal and visceral pleuræ normal. Left lung, upper lobe, normal. Lower lobes a little more filled with blood than normal. A little commencing hypostatic pneumonia and some puriform fluid in bronchial tubes. Right lung, upper lobes normal. In lower, some hypostasis but no pneumonia. Blood from venæ cavæ microscopically examined. Red blood-corpuscles not discernible as such, but, instead, find irregular clusters of pale-red color in which the shape and outlines of blood-corpuscles cannot be discovered, and which look as though a number of softened blood-corpuscles had been melted together. Blood from ventricles of heart shows distinct outlines of red blood-corpuscles not united in rouleaux. The blood-corpuscles here are somewhat pale, and the circumferences mostly crenated.

Abdominal cavity: Contains no fluid. Peritoneum, parietal and visceral, perfectly normal. On upper part of ileum we find, to an extent of one yard, all the perivascular lymph-spaces injected with yellowish-white matter (chyle), so as to be distinct and noticeable over all the intestine. Ileum contains yellowish, mucous matter of normal appearance. In duodenum this mucous matter is more brownish from the coloring-matter of the bile. Colon contains thin yellowish fecal matter. Spleen normal in shape, size, and appearance. Liver normal in shape and size; a little pale and flabby. Tissue on cut surface somewhat pale and flabby from a little cloudy swelling, otherwise natural.

Mucous membrane of mouth, tongue, palate, and pharynx natural. In lower half of esophagus are found numerous small erosions of epithelium, in size from a point to a pin's head, and further down, near the cardia, larger surfaces of epithelium are thrown off.

The stomach is half full. It contains a thin, grayish, alimental fluid, in which white pieces of coagulated milk are disseminated. Mucous membrane of stomach in lower part of fundus and corpus is in a state of emollition from contact with the above-described alimentary contents. But in portions of stomach where the contents are not in contact with the wall we find mucous membrane covered with a whitish, tenacious matter, under which the mucous membrane is natural. No signs of inflammation, therefore no gastro-enteritis. Commencing decomposition. Mucous membrane of duodenum normal; of upper part of jejunum and rest of ileum, colon, and rectum perfectly normal and healthy in appearance.

Kidneys: Normal in shape, size, and appearance, except that the tissue is a little flabby and somewhat pale. No nephritis. Bladder empty, mucous membrane normal Vagina contains some yellow, purulent fluid. Mucous membrane normal. Mucous membrane of cervix and corpus uteri normal. External os uteri shows diffuse superficial erosion, with injection and ecchymosis. Numerous adhesions between uterus and rectum, closing culdesac of Douglas.

Cranium: Heavy, unusually thick. External and internal surface normal. Coronal suture partially closed, especially in middle. Sagittal and lambdoid sutures mostly closed. On the inside no sutures are to be seen. The thickening of the skull is due to an about equal thickening of the three layers. Internal plate is about three or four times as thick as normal. Dura mater shows, on external side, all over right hemisphere, a dark, brownish-gray discoloration that terminates in the median line along the superior longitudinal sinus. Dura over left hemisphere is normal in color. Superior longitudinal sinus contains a little fluid. In cutting through the dura mater over the right hemisphere about 1½ ounces of liquid blood, of dirty brownish color, comes out. Over left hemisphere the inside of dura mater is normal. The gyri are flattened over this hemisphere, not prominent, as normal. Between the dura and pia mater of right hemisphere is a clot of dirty brownish color that has compressed the hemisphere, especially in the region of the temporal lobe and fissure of Rolando. Dura on base of cranium can be easily detached from osseous surface. We find, all over right side as well as in some places on left, especially in the temporal fossa, the following: On inside of dura mater we find a coherent membrane of black, brownish color and considerable resistance, and of from 1 to 2 mm. in thickness. In left temporal region we find some fresh red and not yet discolored patches, where we are able to detach a fine membrane from the surface of the dura mater. This examined microscopically presents, as you will see, connective-tissue fibers and young connective-tissue cells and thin-walled vessels. In the great longitudinal fissure we find the right hemisphere protruding over to left side below the concave border of the falx cerebri, that is, the right hemisphere has been pushed over against left, flattening it. Pia mater is abnormally adherent to gray substance of hemispheres, so that it cannot be detached without, in some places, destroying the surface of the gray matter. Lateral ventricles are a little dilated, and contain slightly more than the normal quantity of clear cerebrospinal fluid. Endothelium in the lateral ventricles is normal. White and gray substance of hemispheres normal in appearance and consistence. No softening or hardening of the brain tissue. Corpora striata and thalami optici normal in appearance and consistence. Vessels of brain are healthy. Surface of right hemisphere is brownish in color from imbibition of hematin from the extravasated blood. Pons varolii, cerebellum, crura cerebri, medulla oblongata, and fourth ventricle are perfectly normal.

Postmortem Diagnosis.—Chronic internal hemorrhagic pachymeningitis, with hemorrhage and compression of brain.

Internal hemorrhagic pachymeningitis, or the *hæmatoma duræ matris* of olden times, is, as you will know from your text-books, one of the rarer consequences of chronic alcoholism. It gives rise to no, or rather to indistinct, cerebral symptoms, and has for its natural termination sooner or later, but inevitably, a hemorrhage sufficient to cause death by intracranial pressure. I make this brief statement merely because the main question we have to discuss today is not the details of the hemorrhagic pachymeningitis, but rather the medicolegal considerations of the case now before us, which are comprised in this one question: Have we before us a case of potassium bromid poisoning, for which some one might be held responsible, or a hæmatoma duræ matris which has come to its natural termination?

From a medicolegal point of view I would not have the slightest hesitation in stating to the coroner's jury that the patient came to her death by the natural termination of a disease of the dura mater, and consequently that no one could be held accountable for her death. Her previous epileptic attacks and the final brain symptoms, stupor, delirium, slow pulse, and lowered temperature, may all be rationally accounted for by the postmortem diagnosis.

So far we have considered the instructions to the coroner's jury, which considers facts only. But, proceeding into the realm of theory, we might ask: Is it possible that such an overdose of potassium bromid as was taken in this case would cause the terminal hemorrhage in an individual suffering from internal hemorrhagic pachymeningitis? The answer must be that nothing is known of such an action of potassium bromid. On the contrary, experiments on dogs and rabbits as to the effect of potassium bromid on blood-pressure have shown that small doses cause lowered pressure and quickened pulse, and large doses lowered pressure and bodily temperature and slow pulse.

The liquid state of the blood and the flabby heart are frequently met with in cerebral apoplexy. Consequently in the autopsy just made there has not been found a single condition traceable to any tangible effect of an overdose of potassium bromid.

VENOUS ANGIOMA OF THE FACE*

REPORT OF A CASE

CHARLES Burns, aged twenty-five, laborer, entered Cook County Hospital September 3, 1879, and was placed under Dr. Fenger's care. The patient stated he knew of no hereditary disease in his family. He had never heard that any of his relations had had a tumor of any kind. He has always had good health, and has never contracted venereal disease. On admission the patient was found to be fairly nourished, appetite good, bowels regular, and so on. On examination a large, lobulated, irregularly ovate tumor was found on the right cheek, as shown in Fig. 38, extending from the inner canthus of the right eye downward and inward to within half an inch of the angle of the mouth; then upward and outward to a point midway between the outer canthus of the eye and the tragus of the ear, and from this point to the inner angle of the eye, involving the greater part of the lower eyelid. The tumor was very prominent, of a bluish-purple color, non-pulsating, but receding on firm pressure. To the touch it was doughy and inelastic. On removal of pressure it slowly enlarged to its former size and shape. It could not be seen or felt on the inner side of the cheek, in the oral cavity, but there was a small purplish spot on the inner side of the lower eyelid. There was also a small tumor, about the size of a pea, and of the same general character as that mentioned above, on the upper lip, to the right of the median line. The patient stated that the tumor was congenital; that it had always covered as large a portion of the face as at present, but that it was not as prominent years ago as it was now. It had never caused him any inconvenience, except when he exerted himself, when it would become more prominent and of a more livid hue, but would soon return to its original size and color.

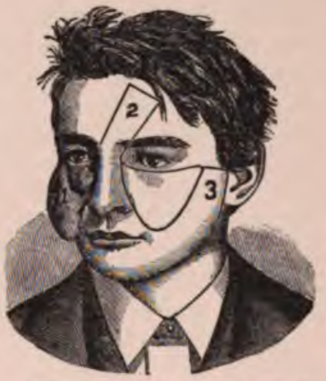

Fig. 38.—1, Angioma; 2, 3, flaps of skin.

September 12th: The patient having been anesthetized, Dr. Fenger proceeded to remove the tumor, making the incision in the healthy skin, near its margin. When he came to the eyelid, it was found that some skin here, and also the orbicularis palpebrarum, could be saved. Numerous bleeding vessels were met with, taken up, and ligated with catgut. The necessary plastic operation for covering the large denuded surface was now performed in the following manner: A flap of skin from the forehead (2), 2½ inches long and 1½ inches broad, was dissected loose down the root of the nose, the pedicle at this point being ¾ inch broad. This flap was turned down and made to cover the upper and inner angle of the wound. The remainder of the denuded surface was covered by a flap taken from the region anterior to the ear (3), having a broad pedicle at its base.

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* Chicago Med. Rev., 1882, vol. v, p. 161.

In the course of the operation ten vessels were ligated with catgut. The flaps were now united with plastic pins and aseptic sutures, and antiseptic dressings, covering both eyes, applied. All the flaps united by first intention. The loss of substance of the skin of the forehead and the region anterior to the ear healed up in seven or eight weeks, being aided by skin-grafting. A prominent, tumor-like thickening at the right side of the root of the nose, where the frontal flap had been bent down, necessitated a slight plastic operation for esthetic purposes, which was performed two months later by Dr. Gunn.

Microscopic examination of the tumor showed that it was covered with the normal elements of the skin, containing hairs, sebaceous and sudorific glands, between which numerous enlarged veins were to be seen, increasing in size from the papillary layer downward. In the location of the subcutaneous tissue were found irregular cavities, varying in size, filled with red blood-corpuscles. The walls of these cavities consisted of a thick layer of fibrillated connective tissue, covered by a single layer of pavement epithelium, the cells of which were very distinct and somewhat smaller than the pavement epithelial cells of the cells of the skin and mucous membranes, and each of which contained a large, well-defined nucleus. The peculiar feature of the epithelium on the walls of the vascular spaces of the tumor was that its cells had rather the solid appearance of epithelial cells, than the finer and more gracile appearance of the endothelial cells. Their outlines and all their constituents were easily visible without any preparation with nitrate of silver or any other chemical or coloring agents. In the deeper parts of the tumor these irregular vascular spaces became larger, and the walls between them correspondingly thinner, but in all cases were covered with the layer of epithelial cells already mentioned.

ON OPENING AND DRAINAGE OF ABSCESS CAVITIES IN THE BRAIN—ILLUSTRATED BY A CASE*

WITH E. W. LEE, M.D.

THE antiseptic method of operating and after-treatment which has been so great a gain to the art of surgery has not as yet been tested to a full extent in operations upon the brain. This is natural for not only have we inherited a just dread of dealing with an organ the large majority of whose diseases are dangerous or fatal, but our knowledge of the physiologic functions of the brain and of their pathologic modifications being extremely limited, we are not in a position to form an accurate diagnosis of such pathologic conditions of the organ as call for surgical interference. However, during the latter decennium science has vigorously attacked the problem, and the brilliant monograph by von Bergmann, "On Injuries to the Head," gives promise that exact observations and pathologic experiments will, in time, enable us somewhat to penetrate the obscurity in which the subject now lies.

We shall, in this paper, confine our remarks to traumatic cerebral abscess, and to such surgical points, their diagnosis and treatment, as may receive some elucidation from the following case.

The principal authors who have written on abscess of the brain (Abercrombie, Lallemand, Griesinger, Bruns, Lebert) nearly all come to the conclusion that it is a necessarily fatal disease. Although some of them, and among them Bruns, were unwilling to deny the possibility of a spontaneous resolution, yet nobody had ever been able to furnish a proof thereof, until Rose, of Berlin, formerly of Zürich, published a case,† in which Wilms had made a diagnosis of cerebral abscess consequent upon internal otitis.

The patient, who was a child, recovered. Many years afterward the patient died as an adult of croupous pneumonia. The postmortem examination revealed five or seven cavities in the brain, the remains of multiple abscesses; these cavities were lined with a thick connective-tissue membrane and filled, one with a serous fluid, the others with cheesy matter. Rokitansky, as early as 1846, writes‡ that cerebral abscess, though usually fatal, may be completely cured.

This possibility of spontaneous resolution, together with the possibility of spontaneous evacuation by ulceration upward through the vault of the cranium, or downward into the orbital or nasal cavity, furnishes the best justification of the surgeon's non-interference with the disease; but when we consider how exceedingly rare is the spontaneous cure of brain abscess, this justification must appear rather slender. In the great majority of cases the surgeon is deterred by the difficulties of the diagnosis. The symptoms of commotion of the brain and of fractures are recognized with comparative ease, but the symptoms of leptomeningitis (inflammation of pia mater) and of emollition or encephalitis proper so closely resemble those of cerebral abscess that the formation of an accurate differential diagnosis often becomes an impossibility. Thus we read of a number of cases in which trephining was performed with a view to evacuate an abscess, and in which the disease afterward found to exist was meningitis or encephalitis.

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* Amer. Jour. Med. Sci., 1884, vol. lxxxviii. p. 17.

† "Ueber Trepanation beim Hirnabscess," Langenbeck's Archiv. f. klin. Chir., vol. xxvii. p. 529.

‡ Path. Anat., Sydenham edition, vol. iii. p. 414.

In not a few of the cases of meningitis (Rivington, Gross, Shallon) the patients died in from three to twenty-four hours after the operation. Such experience naturally makes the surgeon reluctant to have recourse to the trephine, and it does so, perhaps, more than is justifiable, acute leptomeningitis being as necessarily fatal as cerebral abscess, if not even more so. Under such doubtful circumstances the operation of trephining will, in case the disease be leptomeningitis or encephalitis, cut off some hours of more or less unconscious life, but, on the other hand, if an abscess should be present, it may save the patient's life. The aspect of things is widely different in such cases as Dentu's, in which trephining and opening of the dura mater may be assigned as the causes of a subsequent and not preëxistent fatal leptomeningitis.

We are, however, convinced that such disastrous consequences can be prevented by antiseptic precautions—at all events in cases in which it is possible strictly to observe them. This may, indeed, considering the insane violence of patients suffering from brain disease, in many instances prove a matter of exceeding difficulty. We shall consider this point thoroughly in another place. Bergmann, in discussing the treatment of cerebral abscess, unhesitatingly sets it down as an axiom that, "wherever there is an accumulation of pus, trephining is most clearly and indubitably indicated, for the opening of an abscess in the brain is as necessary as in any other part of the body," and, we would add, even more so. A correct diagnosis of abscess having been made, the further difficulty presents itself of locating it with sufficient accuracy, soas to be able to find it. A number of cases are on record (Bergmann cites more than half a dozen) in which a correct diagnosis had been made, the trephine also put on more or less at the right place, but the knife or trocar, the instruments usually employed for the purpose, passing into the brain and near the walls of the abscess, nevertheless missed it. We intend to show, by the following case, that this difficulty can be obviated by multiple exploratory aspirations, performed at interstices sufficiently small to prevent any abscess from escaping detection, even if the trephine opening should not have been made at the point of the skull nearest the abscess.

There still remain to be considered a large number of cases of cerebral abscess on record in which trephining was performed, pus evacuated, and temporary relief obtained—even commencing convalescence; but later on relapse followed and the cases came to a fatal termination. It is possible, judging from the success the practice has met with in the treatment of abscesses in other situations, that drainage of the cerebral abscess cavity, with or without washing out, would have saved some of these cases by preventing the reaccumulation of pus and the continuous infection of the surrounding brain tissue, the acute edema of which is well known to be, as a rule, the final cause of death. As far as we are aware, draining and washing out of cerebral abscess cavities has heretofore not been tried; that it can be effected and, to say the least, without any detriment to the patient, will be shown by the following case:

CASE.—Police officer Patrick Mulvihill, of the Chicago police force, received, on December 3, 1882, about 2 P. M., while attempting to effect the arrest of a criminal, a pistol-shot wound over his left eyebrow. The bullet, as near as could be ascertained, of 32 caliber, struck the barrel of Mulvihill's pistol, and, glancing off, entered the left supra-orbital region. The shot had been fired at a distance of 10 or 15 feet. Patient felt the bullet strike his head, and immediately fell to the floor insensible. He lay thus for about a minute, when, coming to, and feeling but slight pain, he arose and walked up and down the room. A patrol-wagon was called, the patient walked up to it, got in, and was taken to his residence, about half a mile distant, where the wound was dressed. At that time patient could still see with his left eye.

Dr. Howe, who was called, found a small wound of entrance over the left supra-orbital margin where its middle and outer third join. He introduced a probe and discovered that the bone of the margin had been fractured; following the subcutaneous track of the bullet upward and outward for about 2 cm. he distinctly felt a hard body lodged beneath the skin. This was cut down upon, and an irregularly shaped piece of lead extracted. The wound was washed out with a 2.5 per cent. solution of carbolic acid, a small drainage-tube drawn through the whole length of the canal, and an antiseptic dressing applied. Toward evening the lids of the left eye had become edematous to such a degree that, their separation being impossible, the doctor was compelled to refrain from making an examination of the eyeball.

No unfavorable symptoms appeared for forty-eight hours; patient had no pain, and pulse and temperature remained normal.

December 6th: In the morning the patient complained of intense headache, especially on the left side of the head, and of pain in the depth of the orbit. Temperature, 99.5° F. He had vomited once the night before. On removing the dressing, no evidences of suppuration were seen; a slight swelling was noticeable along the track of the wound; the edema of the lids was considerable. Professor Holmes, of the Eye and Ear Infirmary, examined the eye afterward, and found, on separating the lids, a moderate degree of exophthalmos. Patient stated that he had lost vision in his left eye; solution of atropin was dropped into it.

During the subsequent two days the orbital pain and headache continued to increase, but there was no vomiting, nor did other brain symptoms appear. The wound now commenced to discharge freely. Patient was placed under the care of Dr. Lee, who called in Dr. Fenger.

December 9th: Temperature, 102.5° F. Headache steadily increasing. On account of these symptoms we anesthetized the patient and operated upon him, assisted by Dr. J. B. Murphy, who had just returned from Vienna, as follows: An incision, starting from the entrance opening, was carried forward for an inch through the canal of the wound, ending at the point where the bullet had been excised; a second one, beginning at the entrance opening, was made ½ inch downward through the eyebrow and running under the margin of the orbit. This revealed a comminuted fracture of the supra-orbital ridge. A number of small pieces of lead were found among the fragments of bone, and a few of them, impacted in fissures of the ridge, could be removed only by chiseling off the irregular edges of the fracture. An opening was then discovered leading into the frontal sinus, but the probe failed to detect any fracture of, or to find any passage through, the lamina interna into the cranial cavity. A small abscess cavity in the roof of the orbit gave exit to about two drams of pus, but no fracture could be detected there. After washing the wound with a 2.5 per cent. solution of carbolic acid, a large drainage-tube, 7 mm. in diameter, was inserted in the abscess cavity, and a smaller one along the track of the wound, the edges of which were united over the tube by sutures. An antiseptic dressing was put on, and the wound syringed twice daily with a 2.5 per cent. solution of carbolic acid.

December 10th: Temperature, 100.5° F. A little sickness, caused by the ether; otherwise patient has improved; orbital pain and headache have greatly diminished; edema of the eyelids and conjunctiva bulbi as before.

December 14th: Pulse and temperature normal; no headache, no pain; discharge from wound has diminished.

December 24th: Patient feels perfectly well; sleeps quietly all night; has a good appetite; leaves his bed and walks about the house, even up and down stairs. Now and then, but not every day, he is seized with slight attacks of headache, extending over the left side from the frontal to the occipital region. This headache, never accompanied by vomiting or dizziness, would last from two to four hours. Patient's eye could perceive light.

December 30th: Pulse and temperature normal. Patient complains of headache and nausea; he is put on liquid diet and physic.

December 31st: Headache and nausea have disappeared.

January 5, 1883: Pulse and temperature normal; no headache since; the wound has healed down to the apertures for the tube.

As the patient felt restored, he went out-of-doors for the first time since reception of the injury, intending to take a ride in a cutter. While in a police station which he visited he began to feel faint. This was about 1 P. M. He then took a car and rode home. He subsequently vomited, and, feeling a pain in the left half of his head, went to bed. In the evening: Pulse, 70; temperature, normal; he complained of headache and of a feeling of depression; he frequently sighed, but when questioned, answered intelligently.

January 6th: Pulse, 68 and full; temperature, normal; headache and nausea persistent; intellect rather dull, but answers still intelligible.

January 7th: Headache continues; nausea has somewhat diminished; pulse, 63 and increasing in volume; temperature, normal; intellect exceedingly dull.

The pulse now kept falling slowly; the temperature remained normal, and patient became more and more comatose. However, he still answered questions. There was no aphasia and no paralysis.

January 11th, evening: Pulse, 54; temperature, 99.5° F. The coma had reached such a degree that patient could be roused only with difficulty.

January 12th: Patient is in profound coma, and has involuntary discharges of urine. Pulse, 56; temperature, 99° F.

Increasing coma, accompanied by a slow pulse and almost normal temperature, clearly indicated augmented intracranial pressure. This might have been due to—

1. An abscess or collection of pus which had formed between the cranium and dura mater, somewhere in the vicinity of a possible fracture at the seat of the injury.
2. An acute meningitis spreading from the seat of the injury.

3. An abscess of the brain, in spite of the absence of local symptoms. Such an abscess would probably be located in the frontal lobe, not far from the seat of the injury.

In our opinion the normal state of temperature pointed rather to an abscess than to meningitis. Under these circumstances we deemed it advisable to resort to trephining.

The Operation.—Patient was laid on a table. As the coma seemed sufficiently profound to substitute anesthesia, no ether was administered. The left eyebrow and the left half of the head were shaved, and the skin cleaned with soap and nail-brush and a 5 per cent. solution of carbolic acid. The knife was entered at the original wound of entrance, 2 cm. to the inner side of the linea semicircularis superior, and then passed directly upward for a distance of 2 inches, cutting through the galea and periosteum. The trephine employed had a diameter of 17 mm.; it was placed as follows: its lower border 2 cm. above the supra-orbital margin, in order to be sure of avoiding the frontal sinus; its inner border 4 cm. to the left side of the median line, and its outer border 1 cm. to the inner side of the linea semicircularis.

The piece of bone removed presented no fracture, and was perfectly healthy; the underlying dura mater was of normal color, but tense, so as to protrude into the trephine opening; no distinct pulsations were visible. A crucial incision was made in the dura mater, but no pus met with between it and the arachnoid. The arachnoid and pia mater presented their normal color, and there was no trace of meningitic exudation. A hypodermic needle attached to an ordinary hypodermic syringe was now used to make a succession of exploratory punctures. We first pushed the needle downward toward the roof of the orbit, whence nothing was withdrawn but a little blood and débris of brain substance. We then introduced it successively in a horizontal, backward, inward, and outward direction, the result remaining the same. Concluding that the abscess lay at a depth beyond the reach of our needle, we exchanged it for one of greater length. This long needle was entered in a direction backward, slightly inward, and perhaps a trifle upward; on reaching a depth of 2 to 2½ inches, the syringe filled with a thin, palish-red, and semi-transparent fluid. Poured into a wineglass, it emitted a peculiar odor, not distinctly fetid, and somewhat phosphorescent. The needle was pushed in a second time, in the same direction and to the same depth, and again the syringe filled with the same fluid. The needle was now used as a guide, along which the closed blades of a pair of narrow operating forceps were pushed in, and were then withdrawn. On separating the blades of the forceps, 1 to 1½ ounces of the above-described reddish, opaque, thin fluid spurted out with some force, followed by at least a teaspoonful of thick yellow pus. A fenestrated tube, 10 cm. long, 8 mm. in diameter, and 6 mm. lumen, was introduced into the wound in a direction backward, a little upward, and somewhat toward the median line. This tube lay within the dura mater to the extent of 8 cm., and immediately discharged four or five drops of pus; its free end was secured with a disinfected safety-pin. A second drainage-tube was inserted along the roof of the orbit, where, however, no additional pus was discovered. The borders of the wound were stitched together, and a thoroughly antiseptic dressing applied, the opening being covered with a piece of protective silk. The external wound and drainage-tubes were dusted over with iodoform, and the patient put to bed.

Two hours after the operation the pulse had risen to 64; three hours later consciousness returned, and patient answered questions in a slow but coherent manner.

January 13th: Pulse, 68; temperature, 101.5° F. No headache; no nausea. Patient is dressed in a recumbent position, as he feels faint when attempting to assume a sitting posture. The abscess cavity was washed with a saturated solution of boric acid by means of a gentle stream from a fountain-syringe. The drainage-tube was taken out, cleaned, and replaced.

Patient was dressed twice daily for two weeks. From January 15th to January 30th patient improved steadily; pulse and temperature had become normal, and intelligence perfect. Patient no longer complains of headache, sleeps well, and has an excellent ap

Recent observations have, furthermore, shown that local brain symptoms (Herdsymptome) may be met with in cases of meningitis originating in the psychomotor area. It is readily seen that, if an unerring diagnosis is required of the surgeon who proceeds to trephine for cerebral abscess, abscesses in the brain will be evacuated only when pus presents itself at the bottom of the wound, either spontaneously, or on removal of a depressed, penetrating spicule of bone. Indeed, a great number of successfully opened abscesses were just such cases.

Of the opening of abscesses that do not thus visibly present themselves, or are, furthermore, located at some distance from a preëxistent wound, we shall more properly speak under the head of—

2. The Operation of Trephining.—Is trephining at the present day, aided, as we are, by the antiseptic method, still so formidable an operation that, considering the unavoidable uncertainty of the diagnosis, its performance for deep-seated cerebral abscess cannot be pronounced justifiable? Estlander tells us* that, since the introduction of the antiseptic method, the percentage of deaths in cases of cranial fractures with cerebral injury has fallen from 66 to 17, and there is good reason for trusting that thoroughly aseptic wounds will depress the rate of mortality considerably below this figure. In these operations life and death are, of course, to a certain extent in the hands of the operator.

We learn, from statistics published by Blum,† that out of 44 cases in which trephining was performed for abscess of the brain, 22 recovered.

The fatality of the disease, when left to itself, comes near 90 or even 100 per cent. A reduction of this frightful death-rate by almost one-half clearly seems to advocate the operation. Still, as to the advisability of this operation, surgeons will take opposite sides, and Sir A. Cooper's dread of even removing a depressed spicule of bone from the brain, a consequence of disastrous experience, can be traced through surgical literature down to the present day. Rose, as late as 1881, tries to avoid trephining for cerebral abscess,‡ trusting to the faint hope of resolution or spontaneous evacuation. Aseptic trephining—and we should remark that Rose invariably uses the open-air method of treating wounds—undoubtedly deserves to be given an impartial trial before abscesses in the brain, left to themselves, are allowed to run their fatal course.

We conclude from prior reasons and learn from experience that if the brain be healthy, the dangers of aseptic trephining can be greatly lessened by the care and skill of the surgeon. But the objections to operative interference in cases of suppurating leptomeningitis or emollition, *i. e.*, encephalitis, are to be seriously considered. How large a proportion of deaths is to be attributed to the incalculable influence of the shock in giving additional impetus to an existing meningitis or encephalitis it is, of course, impossible to determine. However, it should not be forgotten, first, that these diseases are in themselves exceedingly grave, the prognosis* of traumatic, diffuse, suppurating leptomeningitis being the worst imaginable, namely, death; and, second, that trephining performed under the gravest, we should say premortal, symptoms of intracranial pressure from abscess has, in a number of cases, been followed by prompt relief. The dangers, apart from the shock, cannot very well have any other source than phlogogenous substances introduced into the diseased organ through the trephining wound. It is more than possible that the antiseptic method will prove no less preventive of additional inflammation in cerebral operations than it already has done and does, as is seen in every day's experience, in the opening of cold abscesses from caries of deep-seated bones, of hepatic abscess, of empyema, etc.

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* Virchow and Hirsch's Jahresbericht, 1879, vol. ii, p. 390.

† Langenbeck's Archiv, 1872, vol. xiii, p. 489.

‡ *Loc. cit.*, p. 558.

As to the place where the trephine should be applied, we can only say that it should be chosen as near the seat of the presumed abscess as possible. The difficulties of finding the right place culminated, so to speak, in a case cited by Gross.† A soldier had received a gunshot injury, and seventeen days afterward was suddenly taken with convulsions and coma; five perforations were made with the trephine, but no pus evacuated. The autopsy revealed diffuse leptomeningitis and no abscess.

We believe that the object of multiple trephining—for ascertaining the seat of a deep abscess—can be attained with greater ease and safety by the following procedure:

3. The Exploratory Puncture and Aspiration.—This procedure is not exactly new, but we are not aware that it has ever before been brought into methodic connection with the operation of trephining for the purpose of ascertaining the seat of an abscess. W. T. Renz published a case in 1867‡ in which a punctured wound from a knife in the right frontal region had produced traumatic cerebral abscess. Eleven days after the injury the wound, which had almost healed, was reopened on account of symptoms of compression. The point of the knife was liberated by means of hammer and chisel, and its extraction was followed by the escape of a considerable quantity of fetid matter. An exacerbation of brain symptoms, accounted for by imperfect evacuation, induced the author, some time subsequent to the operation, fearing that trephining might cause prolapse of the brain, to avoid trephining and evacuate the pus by methodic aspiration with a hypodermic syringe. The aspirations were continued twice a day for six weeks. The pus aspirated gradually grew less in quantity and thinner until, at last, the syringe withdrew only a few drops of a yellow, serous fluid. Three weeks of this treatment had effected an entire disappearance of cerebral symptoms. The aspirations were discontinued in the sixth week, and the patient resumed hard manual labor; however, in only five days pain, somnolence, vomiting, and slow pulse recurred. Aspirations were resumed for six weeks, and, as in the author's opinion, diffuse leptomeningitis had now become the cause of these symptoms, mercurial inunctions were prescribed. The patient recovered in half a year, perfectly and definitively. Renz recommends the use of a golden needle, with a shaft rounded up to the point,—*i. e.*,—not cutting,—and of a syringe provided with a somewhat complicated mechanism, to do the work of the hand in moving the piston.

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* Bergmann: *Loc. cit.*, 155.

† System of Surgery, 1872.

‡ Erste Heilung eines traumatischen Gehirnabscesses durch consequente Aspiration des Eiters, ohne vorhergehende Trepanation, Tübingen, 1867.

Renz published his case fifteen years ago. His mode of aspirating without trephining has, as far as we are aware, found no followers in the profession. The reason for this is probably to be sought in the tendency of modern surgery to give free vent to pus wherever met with. Thus Renz's method of curing abscess in the brain by continued repeated aspirations has shared the fate of the same treatment of abscesses elsewhere. After sufficient trial, aspirations have, on the whole, yielded to free incisions.

J. Whitaker Hulke* proceeded to ascertain the seat of an abscess through a trephine opening and healthy dura mater in a manner very similar to ours; but he did not develop it systematically. He introduced a fine trocar into the brain to the depth of about an inch, and removed a little green pus with the aspirator. A narrow-bladed knife pushed in along the cannula opened the abscess and three or four ounces of pus escaped. The longitudinal sinus, which had been opened by the knife, was closed by the double means of suture and ligature. After eight months of intercurrent brain symptoms, among them complete blindness, recovery took place, but the blindness persisted.

Footing on the experience of our case, we propose methodic exploratory puncture and aspiration as a means of ascertaining the seat of the abscess through the trephine opening. The ordinary hypodermic needle, 1 or 1½ inches long, is too short. The one we employed was 4 inches long; its diameter was between 1 and 2 mm., and its bore ½ mm. The needle may be set in an ordinary hypodermic syringe, but one a little larger, of about 3 c.c. capacity, is preferable. This little apparatus is convenient for exploratory aspirations of deep-seated abscess or other accumulations of fluid in any part of the body.

In operating upon the brain it may be well to take Renz's advice and to use a trocar with a rounded instead of an ordinary cutting point. Division of small blood-vessels may thereby be avoided. We used a cutting point, and without any appreciably bad effects.

As to the manner of executing this exploratory puncture, we offer the following suggestions: A well-disinfected needle is pushed in straight in a certain direction for about ½ to 1 inch; the piston of the syringe is then withdrawn a little; if no pus follows, the needle is pushed in ½ or 1 inch further and the piston again withdrawn a little, etc. The depth to which it will be permissible finally to push the needle will, of course, vary with the situation of the trephine opening and the direction of the puncture. In this respect the surgeon will be guided by the anatomy of the brain. The punctures are to be executed at interstices of ½ or 1 inch, the utmost care being observed to push the needle in straight and to avoid all lateral movements. If, after a reasonable number of punctures, no pus is withdrawn, the operator may feel convinced that no abscess is present.

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* "Case of Secondary Trephining for Traumatic Abscess of the Brain; Recovery," Med.-Chir. Trans., 1879, vol. lxii. Lancet, 1879, vol. i, p. 406.

As an abscess is generally about the size of a walnut,—and it is seldom smaller,—it will necessarily be detected by this procedure. We are convinced that, in a number of cases on record, failure to find the abscess might have been prevented by methodic exploration.

Puncturing of healthy brain substance with a fine, perfectly aseptic needle can do but little mischief. We know from our writers, as well as from our own experience, and we intend to publish a case in point in connection with another subject, that puncturing of a brain in which no inflammation is present does not give rise to even the slightest untoward symptoms. But how does the matter stand when the brain is affected with diffuse leptomeningitis or abscess? A needle passing through a focus of inflammatory products and entering healthy tissue may, undoubtedly, carry bacteria or phlogogenous substances from the former into the latter. This would, in the worst case, produce encephalitis or secondary abscess. In case of meningitis the life of the patient will, in all probability, terminate, independently of the puncture, before such a consequence has time to develop sufficiently to attract our attention. In case of abscess our manner of exploring, pushing the needle gently and gradually from the superficial into the deeper parts, can hardly be said to be attended with any great risk of such a result. A third possibility is that the needle may run into a ventricle and draw off some cerebrospinal fluid. Detmold* opened the lateral ventricle with a knife and evacuated a quantity of pus. His patient died five days afterward. But opening a ventricle with so coarse an instrument as a knife, and puncturing it with a fine needle, withdrawing only a few drops of the contained fluid, are proceedings that scarcely admit of comparison. As to this point, however, we must wait to be taught by further experience.

Having ascertained the site of the abscess, the next question is how to open it. This has commonly been done with a knife, but we should avoid the use of cutting instruments in order to preclude the possibility of hemorrhage. The soft substance of the brain is easily penetrated with a probe, a pair of forceps, or any other sort of blunt instrument, which may be pushed in along the needle as a guide.

The question that still remains to be considered is the advisability of draining cerebral wounds.

4. Drainage of Brain Abscess.—*A priori* reasons do not plead in favor of drainage of the brain with tubes. A drainage-tube is a foreign body, and we know that the presence of a foreign body, even when perfectly aseptic, *e. g.*, a depressed fragment of bone in a case of subcutaneous fracture, penetrating the dura mater and entering the brain tissue, is apt to give rise to general as well as local brain symptoms, although no suppurating inflammation may have set in. But a depressed spicule of bone still connected with the immovable skull and descending into the movable brain substance is certainly very unlike a free drainage-tube running into an abscess through a trephine opening. As in most cases in which trephining was performed the symptoms caused by the irritation of the foreign body disappeared on its removal, the introduction of a new foreign body, in the shape of a drainage-tube, may have seemed a little paradoxic, and this may help to explain the fact that, as far as we have been able to learn, no attempts have been made, with the exception of one, to employ drainage-tubes in the treatment of brain lesions. In the one instance which has come to our knowledge—a case of pistol-bullet wound of the brain, related by Burckhardt—it proved a remarkable success.* A man of sixty-two years, attempting to commit suicide, inflicted a gunshot injury upon himself in the right parietal region. The cranium was trephined, but the bullet was not extracted. A drainage-tube was inserted along the track of the projectile, the wound stitched together, and an antiseptic dressing put on. A capsule formed around the bullet, and the wound healed without suppuration. The symptoms in the case were paresis, anesthesia of the opposite half of the body, and traumatic insanity. The man recovered. Twenty months later he succeeded in committing suicide. The autopsy revealed a band of connective tissue filling the canal of the bullet, and running transversely from the parietal bone to the falx cerebri. The greater portion of the bullet was found encapsulated near the latter, and a few bits of lead were embedded in the connective tissue filling the canal.

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* Amer. Jour. Med. Sci., 1855, p. 86.

These two cases, Burchard's and our own, are, of course, too isolated to prove that cerebral drainage will always turn out as a safe proceeding, but they certainly justify further trial, especially when we consider that, under the old treatment, after successful opening of the abscess the patients succumb at the rate of 50 per cent. Moreover, drainage is, at the present day, recognized to be an all-important factor in the treatment of abscesses in general.

Whether it is essential or advisable to wash out an abscess in the brain after drainage has been established is a matter of some doubt. Opinions as to the washing out of abscesses in general somewhat diverge, and it need hardly be remarked that an organ as delicate as the brain should be interfered with as little as possible. The majority of surgeons, however, doubtless favor washing out of fetid abscesses wherever else found, and already Rokitansky states† that "the thick green pus contained in an abscess of the brain is extremely fetid and phosphorescent." We may entertain a reasonable hope that washing out—*i. e.*, disinfecting—fetid abscesses of the brain will prevent the setting up of edema or encephalitis in the neighboring tissues, which secondary diseases are well known to be far more dangerous than the abscess itself. In fact, in the majority of cases they constitute the final cause of death.

As to the wash employed, we first chose boric acid, it being of all disinfectants the most harmless; but we were compelled, at least we so believed, to substitute the stronger antiseptic, carbolic acid, and the change was apparently followed by good results.

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* Burckhardt: "Ein Beitrag zur Casuistic der Schusswunden des Gehirns, mit Einheilen des Projectils," Deut. Zeitschr. f. Chir., 1881, vol. xv, p. 582.

† *Loc. cit.*, p. 413.

In conclusion, supported as we are by a single case, we do not wish to recommend any unreasonably bold or hazardous proceedings in so difficult and delicate a matter as the surgical treatment of cerebral abscess. We think, however, that the procedures instituted in the above case strictly conform to the rational methods of modern surgery in treating abscesses in general; and because of this, and not because our patient recovered, we regard the above case as answering in the affirmative the question: Is it probable that abscesses in the brain can be treated advantageously on the same principles as abscesses in other parts of the body?

ON SURGICAL TREATMENT OF GANGRENE OF THE LUNG*

SINCE Mosler's drainage of a tuberculous cavity, pulmonary surgery has received considerable attention. Clinical observations have been made by Mosler, Pepper, Koch, Bull, Hollister, and myself, and the subject has been studied in an experimental way by Gluck, Schmidt, and Bloch. In 1882 Bull, of Christiania, was able to tabulate 19 cases where operations had been performed for various kinds of pulmonary cavities. I shall limit my remarks here to cases of acute pulmonary gangrene. So little is known in this branch of surgery that it is safe to draw conclusions only from similar or identical cases. Acute gangrene of the lung, as is well known, is either diffuse or circumscribed. Diffuse pulmonary gangrene has never as yet been, and probably never will be, interfered with surgically. Aside from its being, in all probability, an inevitably fatal disease, the course it runs is so acute, it is accompanied by such symptoms of depression and asthenic fever, that the condition the patient is found in will almost always exclude the thought of an operation. Circumscribed pulmonary gangrene, on the other hand, runs a more chronic course, its symptoms are less grave, and the patient, often for many weeks, retains sufficient strength to bear the strain and shock of an operation. In this respect surgical interference is justifiable. It has, indeed, been thought of and resorted to four times within the last five years by men in different countries, and more or less independent of each other, not having any accurate knowledge of each other's doings in this particular department of our science.

Let us briefly call to mind what is known about circumscribed pulmonary gangrene. It may be caused by an embolus, a bronchitis, or a pneumonia; but no matter what its cause is, it presents itself in the beginning as a necrotic portion of lung tissue, varying in size from that of a bean to that of a hen's egg. This necrotic piece of tissue is sharply defined; after a while it is isolated from the living pulmonary tissue by a demarcating inflammation. It then lies in a cavity as a foreign body. It may be found there, according to Rokitansky, as a blackish-green, shaggy, and moist plug, bathed in ichorous fluid, and of considerably smaller size than the cavity. It however happens still more frequently that the necrotic piece does not keep together in one mass, but is dissolved into a grayish-brown, very fetid ichorous pulp, which is mixed with rotten, shaggy fragments of tissue; the walls of the surrounding cavity are lined by the same shaggy tissue infiltrated with ichor. The surrounding pulmonary substance is sometimes normal; more frequently it is in a state of inflammation, which has a stage of, or terminates in, hepatization. This hepatization may extend through the whole lobe affected with the gangrene.

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* Jour. Amer. Med. Assoc., 1884, vol. iii, p. 62.

In cases in which the gangrenous cavity communicates with the bronchus, the bronchus affords a channel for the evacuation of shreds of necrotic lung tissue. The suppuration going on in the walls of the cavity may eliminate all the adherent shreds of dead pulmonary tissue; an abscess may form which, after evacuation of its contents, may close up, the abscess cavity may contract, and, finally, nothing is left but a scar to indicate the spot where there once existed a circumscribed pulmonary gangrene. Such spontaneous recoveries may take place, but how often they do so, and under what circumstances, is altogether unknown. The usual course of circumscribed pulmonary gangrene is quite different. A gangrenous focus from which the disease does not extend nor spread is rare. In many cases gangrenous destruction going on in its walls enlarges the cavity, and during this process the patient dies of exhaustion; in others, gangrenous matter is aspirated from the cavity up into the bronchial tubes, deposited in other parts of the lung, and a diffuse gangrene is produced. In a third class of cases the patients do not die during the course of the gangrene. The gangrenous cavity is emptied of its fetid contents, transformed into an abscess cavity, and the odor of the breath and sputa disappears, the patient's appetite returns, he grows strong, and makes an apparent recovery. However, the abscess cavity does not close up nor contract; after months or years of more or less impaired health the contents of the cavity undergo decomposition. The walls of the cavity are constantly being destroyed, and even a second gangrene may set in. The patients die of exhaustion, which, in the latter case, is accompanied by the usual symptoms of pulmonary gangrene. We know this much, that circumscribed pulmonary gangrene terminates in perfect recovery only when the gangrenous cavity is small. In the great majority of cases the disease ends in death.*

The prognosis of acute circumscribed gangrene of the lung is, of course, always grave. In any given case it is, during the whole course of the disease, impossible to foretell whether it will terminate in death or in recovery. A diffuse pulmonary gangrene, a gangrenous pyopneumothorax, may supervene at any time, or the patient may die of exhaustion due either to the progressive local destruction or to the accompanying fetid bronchitis. The internal remedies at our disposal at the present time can hardly be said to have any effect as far as regards checking the progress of the disease. They merely aid in sustaining the patient, in keeping him alive until the gangrenous process has come to an end.

These facts, well considered, seem to justify the attempt to cure

* *Vide* Herz, in Ziemssen's Cyclopædia.

the disease by surgical measures—by them alone can we hope to put a stop to the progress of the local gangrenous destruction. Operations on the lungs with a view to bringing about the healing up of gangrenous cavities have been performed in the four following cases:

CASE I.—Cayley and Lawson reported the following case at a meeting of the Clinical Society of London:*

A man, forty-five years old, was admitted to the Middlesex Hospital December 30, 1878. He had previously been laid up for five weeks with an acute pneumonia of the left lung. At the time that he entered the hospital he presented the usual symptoms of pulmonary gangrene, with formation of a cavity in the lower lobe of the left lung. The general condition of the patient was not at all favorable for an operation. After an exploratory puncture had confirmed the diagnosis, Mr. Lawson made an incision in the ninth intercostal space just below the angulus scapulæ. The cavity was evacuated, washed out, and a drainage-tube inserted. Patient felt very much relieved, but four days after the operation he collapsed and died. Dr. Cayley pointed out that the only chances the patient had of prolonging his life were those given by the operation, and that, if the patient had come under treatment earlier, his prospects would have been better. At all events, the operation gave the patient some relief.

CASE II.—*Gangrenous cavity in the middle lobe of right lung subsequent to croupous pneumonia. Insufficient outlet through the bronchi. Adynamic condition of patient. Incision in the region of the angle of the scapula. Drainage, with injections of carbolized water. Decided improvement for a week. Cessation of fetor of breath and expectoration. Return of fetid expectoration. Collapse and death twelve days after the operation.*†

The patient, a man about sixty years of age, had always been in good health until two months previous to the operation, during which time he had had a little shortness of breath on going uphill. Two weeks previous to the operation he had a sudden attack of pneumonia of the right side, with chills, pain in the right side, pneumonic crepitus, and rusty sputum. The case was not very severe, the temperature never exceeding 102° F., and in about a week he got up. Two days later the cough became worse, he felt weak, had to go to bed, and his breath had an offensive odor.

On October 13th he suddenly expectorated half a pint of fetid gray fluid, and sank rapidly into a condition of collapse. On the next day the patient was covered with clammy perspiration, his respiration was rapid and difficult, with loud tracheal râles; pulse, 130, very feeble; could not lie down on account of the cough. The air of the whole room was extremely offensive on account of the gangrenous odor of breath and expectoration. The matter expectorated was principally a thick, tenacious, mucopurulent mass, but frequently alternating with this was a thin, gray, offensive fluid, which seemed to gush into his throat suddenly in such quantity that he would spit out mouthful after mouthful of about half an ounce each for three or four times in succession. The right side was slightly less resonant than the left, especially at the base and at and under the right nipple. There was less respiratory sound on the right side and less vocal vibration, but all the sounds were greatly masked by tracheal râles. He had no pain; the tongue was brownish-black and dry, and the patient was very weak. Under invigorating and stimulating treatment he seemed to improve a little for a day or two, but then the expectoration diminished and he became worse. Four days later a quantity of the same fetid fluid as before was expectorated, and he felt a little relieved, but soon afterward the expectoration stopped again and the adynamic condition of the patient increased.

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* Lancet, 1879, vol. i, p. 440.

† Solomon Charles Smith, Lancet, 1880, vol. i, p. 86.

On October 20th distinct cavernous respiration was heard below the spine of the right scapula, and external to and below the right nipple. The diagnosis was now made of a large cavity extending chiefly through the middle lobe of the right lung, with no efficient outlet for the contained fetid matter, and a consequent adynamic condition of the patient from poisoning by the fetid pus. It was now resolved to operate, with a view toward procuring an outlet for the fetid matter, for the following reasons:

1. That the actual condition of the patient made it certain that he would die, and that very speedily.

2. That there would be some chance for his life if the cavity could be found and an opening made.

3. That it would be justifiable to explore with an aspirator, and if the cavity was found, to enlarge the opening and put in a drainage-tube.

At a point near the angle of the scapula an aspirator needle was inserted for three or four inches. No fluid escaped, but very fetid air was drawn through the tube. On holding a candle near the cannula, the flame was blown to and fro during respiration, so that evidently a cavity had been reached.

Using the cannula as a director, a knife was inserted between the ribs, and by the side of the knife dressing forceps were slipped in and the wound enlarged sufficiently to allow the introduction of a small india-rubber tube. Through the latter a little carbolic acid solution was injected. This seemed to occasion a fit of coughing, when about half a pint of fetid pus, of the same character as the former offensive expectoration, was forcibly expectorated. The tube was left in the wound, which was covered by a large pad of a dozen folds of coarse muslin, wrung out of a solution of carbolic acid. This dressing was ordered to be changed every three hours.

For the first week after the operation the improvement was very decided. For six days the expectoration was very much diminished. The fetor also became much less, except at the time when the dressing was changed. He enjoyed his food more, and was altogether more comfortable. The respiration became much clearer in the left lung and the unaffected parts of the right lung, the moist sounds being much less frequent, and the tracheal râles only occasional. The discharge from the wound, however, continued extremely offensive, notwithstanding the daily irrigation of the cavity by a siphon. Whenever the dressing was changed, it was found to be soaked with a discharge for an area of 5 or 6 inches in diameter. As the water which escaped on washing out the cavity was only slightly stained, the offensiveness was attributed not to any retention of pus, but rather to sloughing within the lung.

Eight days after the operation the discharge had lessened a good deal, but the expectoration now increased and again became offensive. The pulse increased to 112; temperature, 100° F. On the next day, in the morning, he was better, had less cough and expectoration, and took food well; but the wound was beginning to slough, and a few gangrenous black shreds were discharged through the drainage-tube. In the afternoon he became very ill, with labored breathing, quick pulse, and profuse cold sweats. From this time he gradually became weaker, would take no more food, and died November 2d, apparently from simple asthenia. An autopsy was not held.

Case III.—A girl of twenty-three years was admitted to the hospital of Christiania December 13, 1880.* A month previous to her admission she had caught cold, began to cough and to expectorate yellowish, mucopurulent sputum. One week afterward her sputum, and a little later still her breath, became fetid. Two weeks later she had a rigor, and at the same time began to complain of pain in the left lung. The color of the sputum was now brownish red. She lost strength and had no appetite. At the time of her admission into the hospital her pulse was 104; temperature, 102° F.; respiration, 30. She coughed a great deal and expectorated a frothy fluid of fetid odor and tinged with blood.

* E. Bull: Nord. Medic. Arck., 1881.

In the left axillary region the percussion-note was dull, slightly tympanitic, and large râles were heard.

On January 4th were discovered, in addition, the signs of a pleuritic effusion which extended over the posterior side of the left lower lobe. A few days later an exploratory puncture was made in the fifth intercostal space, in the anterior axillary line. The syringe drew a bloody, serous fluid which contained a great number of leukocytes.

January 19th: Auscultation over the fourth intercostal space, near the anterior axillary line, gave the signs of a cavity. An exploratory puncture was here made with a Pravaz syringe, which withdrew a few drops of a bloody, purulent, fetid fluid. An exploratory puncture made below the left angulus scapulæ showed the effusion into the pleural cavity to consist of a clear yellow, serous fluid.

A gangrenous cavity was diagnosed, situated in the lower anterior part of the upper lobe of the left lung, and serous pleuritic effusion extending over the lower lobe of the left lung. The advisability of an operation was discussed.

On the twentieth of December a swelling was found in the outer half of the left mamma, just where the exploratory puncture had been made in the gangrenous cavity. It was tender to the touch. The following day a subcutaneous emphysema was discovered on the anterior side of the left half of the thorax. A small incision made in the above-described swelling gave exit to a little fetid reddish pus. On the twenty-fourth the patient was anesthetized, and a transverse incision, 2 inches in length, was made across the fourth intercostal space, and an abscess cavity found below the mamma contained a few tablespoonfuls of gangrenous pus, which was evacuated. In the fourth intercostal space an opening was effected with a pair of dressing forceps which were cautiously worked through the intercostal muscles and the adherent pleuræ. The index-finger introduced through this opening moved around in a cavity whose walls were composed of soft, friable, shaggy tissue. The cavity was washed out with carbolized water, a drainage-tube inserted, and an antiseptic dressing applied. After the operation her pulse was 128 and her respiration 40. In the afternoon she coughed up a couple of tablespoonfuls of fresh blood. On January 25th she coughed less and felt better. On January 31st in the afternoon she had several small hemoptyses, and during the following days she expectorated matter considerably tinged with blood. Between the third and the tenth of January the fetor of her breath would diminish one day and be worse the next. After the tenth of January her general health began to improve, the cough diminished, her appetite returned, and she felt stronger. After January 14th her breath and expectoration were free from odor; one week later the cough ceased entirely, as did also the fever. The wound healed, and the physical symptoms gradually became normal. After a long convalescence she recovered her full health. About six months after the operation she was able to resume her work as a servant girl.

CASE IV.—John Schubert, a German laborer aged thirty-nine, had healthy parents, but does not know the later history of his brothers and sisters. Habits good. No venereal disease. Was healthy until nine years ago, when he had to keep his bed for a few days, the symptom of his sickness being fever. He made a perfect recovery. Five years ago he was taken sick with pneumonia, which he thinks was of the right lung, though he is not sure. He was then very sick for a few weeks, and recovered. As he became subsequently a member of a lodge and was examined by their medical examiner, it is presumable that recovery had been entire. During this last winter he worked in a packing-house, and coughed more or less the rest of the winter.

February 29th: After a week of aggravated cough he had a chill which lasted a couple of hours, and took to his bed March 4th. Dr. Valin was called to see him March 5th. The respiratory murmur was absent from the lower third of the right lung, and rather increased elsewhere.

Dullness was well marked over the same area, and pain was also complained of in that region, but there was some sensation of pain around the outer border of the diaphragm all around the chest.

There had been constipation for several days, to relieve which he was drinking an infusion of senna tea. The expectorations were mucous and frequent; the respirations, 42 a minute and distressing. The pulse was 112; the temperature, 102° F. He was given whisky, 2½ grains quinin every three hours, and liquid Dover's powder ½ dram, every four hours.

March 6th: Rusty sputum was expectorated, which continued for a week, streaks of blood also being present at times. Temperature during that time varied from 101° to 103° F. By March 15th the expectoration increased, and became more and more purulent. On March 30th the patient, upon very slight exertion, raised half an ounce of blood, and for the next three days some streaks of blood were present in the sputum, which from that time had a quite offensive odor.

April 5th: Patient, upon trying to get up, had another hemoptysis of about three ounces of blood.

April 6th: I found the patient lying in bed; pulse, 110; temperature, 101° F; respiration, 34. The air in the room, and especially in the neighborhood of the bed, had the fetid odor peculiar to gangrene. Patient's cheeks were a little flushed; otherwise he was pale, looked suffering, and somewhat collapsed. He was troubled with a distressing cough, which prevented him from sleeping during the night. In the twenty-four hours he raised more than a pint of expectorated matter, which, on being poured into a glass, showed the three layers characteristic of pulmonary gangrene—an upper frothy layer, a middle layer, consisting of a grayish thin fluid, and a bottom layer, consisting of yellowish, mucopurulent matter streaked with blood, and also showing streaks and flakes of a dark-gray color. Stethoscopic examination revealed the left lung and the heart to be normal. Percussing the right half of the chest, a clear note was obtained in the supraclavicular, the infraclavicular, and in the mammary region as low as the upper border of the fourth rib. Below this the percussion-note was dull. In the axillary region there was likewise resonance down to the fourth rib, and dullness below and in the infra-axillary region. Percussion on the back gave a clear sound in the supraspinous and infraspinous regions; in the infrascapular region the note heard was not exactly dull, but less resonant than on the other side. On auscultation normal vesicular respiration was heard in the supraclavicular and infraclavicular and in the upper axillary regions. On the posterior surface of the lung vesicular respiration was accompanied by large mucous râles. No distinct respiratory sounds could be detected in the area of dullness in the infra-axillary and inframammary regions. At a point one inch below the nipple, on the fifth rib, a "ventillant," a sound produced by the opening and closing of a valve, could be distinctly heard. No other signs of the presence of a cavity were as yet perceptible.

The case presented no difficulties to the formation of a diagnosis of pulmonary gangrene in the anterior part of the lower lobe of the right lung. It was furthermore evident that more palpable signs of a cavity would soon develop, which would be situated in a part of the lung accessible to surgical interference. I advised the patient to go to the hospital, and, as his life might possibly be saved thereby, to have an operation performed as soon as the evidences of a well-marked cavity would appear to be sufficient to justify operative measures. He was admitted to the Cook County Hospital April 11, 1884. On account of the unbearable stench surrounding him he had to be removed from the common ward and put in a separate room. In the mean time cough and expectoration remained unchanged; he grew weaker, had been delirious at times, and his appetite was entirely gone; his bowels were regular.

April 12th, A. M.: Pulse, 104; temperature, 100.2° F. P. M.: Pulse, 112; temperature, 101° F. The right lung was again examined, and the area of dullness found to be unchanged, stretching from the fourth rib downward over the inframammary and axillary regions. But in the center of this area there was now a smaller one, in which the percussion-note was tympanitic; it extended 1½ inches downward from the right nipple, and 3 inches transversely from the axillary into the inframammary region. Auscultation of this tympanitic area revealed distinct amphoric respiration and amphoric or metallic râles.

April 13th: Operation. At 11 o'clock in the morning, in the presence of Drs. Murphy, Baxter, and Randall, of the attending staff of the Cook County Hospital; of Dr. Valin, patient's former medical attendant; of Dr. Verity, and of the house staff of the hospital, patient was anesthetized. A puncture was first made with a hypodermic needle in the mammary line, just below the fifth rib. From a depth of 1½ to 2 inches the syringe drew a thin, grayish-red fluid, which, on being poured into a glass, emitted the characteristic odor of gangrene. A transverse incision was now made, 3 inches long, parallel with the fifth rib, and having its midpoint in the mammary line. The fifth rib was bared, and a 1½-inch piece was resected subperiosteally. A hypodermic needle detached from its syringe was thrust in through the costal pleura; on being let go it was observed to make slight movements corresponding to the respiratory movements, but they were not of sufficient extent to disprove the existence of adhesions between the two layers of the pleura. A long hypodermic needle was then screwed on the syringe, and was thrust in in different directions until the syringe again became filled with gangrenous fluid. The syringe was unscrewed from the needle while the latter remained in place, in order to be used as a guide leading into the cavity. A large, funnel-shaped canal was made with Paquelin's cautery, which was gradually pushed along the needle through the pleura and the subjacent pulmonary tissue until, at a depth of about 1½ inches below the pleura, the cavity was entered. The opening was sufficiently enlarged to permit the index-finger to enter the cavity, whose dimensions were found to be, on palpation, 3½ inches, transversely, 2½ inches from above downward, and about 1 inch anteroposteriorly. The walls of the cavity were felt to be rather firm and indurated. No shagginess nor detached shreds of pulmonary tissue could be detected. Drs. Baxter and Valin, who also made a digital exploration, confirmed these statements. The cavity was then washed out with a saturated solution of salicylic acid. As soon as it had filled, a vehement cough expelled the fluid mixed with air. Two large fenestrated drainage-tubes, and one of smaller size, which was not fenestrated, were introduced into the cavity and held in place by a stitch to the skin. The whole operation was performed, so to speak, bloodlessly, as boring the pulmonary tissue with the cautery produced no hemorrhage. The incision wound was left open, was dusted over with iodoform, and a heavy antiseptic dressing applied. Patient was brought to bed, and warming bottles were placed along his extremities.

At 1.30 P. M. of the day of the operation the patient rested quietly; his cough had become less frequent. At 3 P. M. he asked for something to drink, and was given a glass of milk. Champagne, egg, lemonade, and milk with seltzer were ordered to be given when required. At 7.30 P. M. the pulse was 84; temperature, 101.2° F. Patient felt comfortable; he had some soreness and pain in the neighborhood of the wuond. He was given a hypodermic injection of morphin and atropin and some cough medicine.

The air in the room was not exactly offensive. The fetor of the expired air had diminished so much that I could now sit by the patient and speak to him without covering his face with a towel, as I had always been obliged to do before.

April 14th: Patient had passed a comfortable night; pulse in the morning, 96; temperature, 100.4° F. In the evening, pulse, 96; temperature, 101.2° F. His cough had gone on diminishing. The expired air and the sputum still emitted a gangrenous odor; the quantity of the expectorated matter was about ½ pint. The dressings were saturated with a bloody fluid smelling of gangrene. The cavity was washed out with a solution of salicylic acid; this brought on violent coughing, which caused several shreds of lung tissue, one of them 1½ inches in length, to be thrown out at the wound through and beside the drainage-tubes. Toward the end of the coughing spell the fluid ejected from the cavity was tinged with blood. The walls of the canal I had made with the cautery through the pulmonary tissue were covered with a grayish-brown eschar.

April 15th, A. M.: Pulse, 92; temperature, 100° F. Patient had passed a comfortable night, although he had not received any morphin. P. M.: Pulse, 92; temperature, 101.2° F. Patient was dressed; odor less marked; further shreds of lung tissue were thrown out.

April 16th, A. M.: Pulse, 90; temperature, 100° F. P. M.: Pulse, 94; temperature, 100.5° F. Patient was dressed. There was less discharge and less odor; a few fragments of pulmonary tissue were thrown out.

April 17th, A. M.: Pulse, 84; temperature, 99.6° F. P. M.: Pulse, 90; temperature, 99.8° F. Patient commenced to eat solid food.

April 18th, A. M.: Pulse, 85; temperature, 99° F. P. M.: Pulse, 84; temperature, 100.2° F.

April 18th: The wound had so far been dressed every day. The cavity was washed out but slightly, on account of the distressing cough which invariably followed. There was now scarcely any odor to the breath or the sputum, which had diminished considerably in quantity. The whole (external) wound was now covered with granulations. The walls of the canal presented a gray pigment; they were smooth, bloodless, and had the appearance of a cut surface of pulmonary tissue in a state of gray hepatization.

April 19th, A. M.: Pulse, 84; temperature, 101° F. This was the last time that the temperature was found to be higher than normal.

April 23d: Pulse and temperature normal. Patient slept well, his appetite returned, and breath and sputum had become odorless. The quantity of the expectorated matter, which was mucopurulent in character, had been reduced to 2 or 3 ounces in the twenty-four hours. A small amount of yellow pus which, however, had no odor, was found in the dressings. This same thin yellow pus mixed with air was seen in the cavity instead of the former grayish or grayish-red, thin fluid. The walls of the canal were pretty well covered with a layer of granulation tissue.

April 29th: The old drainage-tubes were removed and substituted by a single one the size of a finger.

May 1st: Patient continued to sleep well, had an excellent appetite, and was gaining flesh. He coughed once in a while, and during the day he raised about 1½ ounces of mucopurulent sputum. In the area of dullness surrounding the cavity fine subcrepitant râles were heard.

May 4th: The opening into the cavity had contracted considerably. As the drainage-tube was found pushed out several times and lying in the dressings, it was not again replaced.

May 11th: The wound, which had not been dressed for five days, was mostly healed. A small fistulous tract only remained, which communicated with a bronchus, for a few drops of yellow pus mixed with a little air were forced into the wound when the patient was made to cough. On percussion of the chest resonance was obtained in the inframammary region down to the fifth rib; in the axillary region down to the sixth rib. Dullness only remained in an area about two inches in diameter right around the wound. The fine subcrepitant râles had disappeared. [illegible] vesicular respiration all around the fistula; [illegible]

[illegible] re normal; there were no râles.

[illegible] day.

[illegible] ll in every respect. A small fi[illegible] ses in for a distance of 2½ in[illegible] escapes from this fistulous ope[illegible] of tincture of iodin into the fistula, a violent fit of coughing was thereby produced. The sputum raised by this cough contained brown specks of tincture of iodin which could be seen with the naked eye. They were proved to be iodin by the starch test. It is evident that this fistula is still in communication with a bronchus.

Patient left the hospital.*

These cases, though only 4 in number, showing 2 deaths and 2 recoveries, satisfactorily prove to my mind that opening a pulmonary cavity in acute cases of circumscribed gangrene of the lungs is a justifiable operation. In not one of the above cases did any mischief, or even any inconvenience to the patient, result from the operation. On the contrary, the immediate effect of the operation was a very decided improvement in the condition of the patient, even in the 2 fatal cases. The distressing cough was, in every one of these 4 cases, greatly diminished at once. The explanation of this is to be sought not only in the immediate evacuation of the gangrenous contents of the cavity, but also in the fact that the fluid reaccumulating in the cavity largely ran off through the drainage-tubes, whereas before the operation it had been aspirated up into the bronchi, thereby producing a more or less extensive fetid bronchitis. This bronchitis ceased very rapidly, and there can be no doubt that it, more than the presence of the cavity itself, is the cause of the constant coughing.

The fetor of the breath and sputum diminished simultanously with the cough, as would naturally be expected.

As to the cause of non-success in Cayley and Lawson's case, the authors themselves state that the operation was performed too late, and that it might have been successful if it had been performed at an earlier stage of the disease. In Smith's case no autopsy was held, and so nothing can be known as to the cause of its failure. Bull's case and my own have this in common, that in both the cavity closed in about four weeks; that the fever decreased together with the fetor of sputum, and ceased in Bull's case in three, in my own case in two, weeks after the operation. Cessation of the fetor was followed by improvement in the general condition of the patient, whose appetite and strength returned.

I now wish to add a few words concerning the operation itself and the after-treatment.

Operation.—We should operate as early as possible, that is, as soon as the physical signs of a cavity have become manifest. We should not operate, for anatomic reasons, when the cavity is covered by the scapula or is situated in the apex of the lung. The latter will hardly ever happen in cases of pulmonary gangrene. The location of the cavity should be ascertained by making an exploratory aspiration with a fine needle. The opening into the cavity should be made at the spot where the cavity comes nearest the surface, for not only should we injure as little lung tissue as possible, but we should also have the shortest possible canal into the cavity; the shorter the canal is, the easier will it be to keep it open and to drain off the contents of the cavity. Besides, we may reasonably expect to find pleural adhesions where the cavity is most superficial. These will prevent the operation from causing a pyopneumothorax. It almost seems that, under these particular circumstances, our natural dread of opening a pleural cavity is founded on theory more than on practice. In not one of the 20 cases now on record in which pulmonary cavities were opened did such a complication occur.

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* For valuable assistance in the after-treatment I am greatly indebted to Dr. E. P. Davis, then house surgeon at Cook County Hospital.

The incision should be made parallel with the ribs, one or more of which should be resected if necessary. It is essential to have free access to the cavity, as well for the immediate digital exploration made for the purpose of removing large pieces of dead pulmonary tissue as for the sake of having a wide canal (subsequently) into which sufficiently large drainage-tubes can be introduced. Experience has shown that these canals are liable to contract and close up before the pulmonary cavity has become obliterated.

The canal leading through the pulmonary substance into the cavity is best made by means of the thermocautery, as was proposed by Albert and Koch. Their method has been strongly advocated by Mosler as being superior to any other as yet suggested. The smaller burner of Paquelin's cautery should, as was done in my case, be gradually worked in through the substance of the lung along a detached hypodermic needle which is used as a guide. The cautery will thus be pushed in not merely in the direction of the cavity, but also in the shortest line existing between the latter and the surface. Working slowly with the red-hot cautery will produce no disturbing hemorrhage from the pulmonary parenchyma, and the canal can easily be enlarged to such size as may seem convenient. Having reached the cavity, we should explore it with the index-finger; if large and detached pieces of lung tissue are discovered, we should remove them with a pair of forceps, being very careful to avoid causing any hemorrhage by tearing off still adherent shreds of pulmonary tissue. Our knowledge that it is not uncommon for the walls of a gangrenous cavity to bleed considerably will render us cautious while making the digital exploration.

Whether it is advisable or not to make a counteropening for the sake of facilitating drainage and washing out of the cavity can as yet hardly be stated. It has not been tried in any of the cases in which operations were performed for pulmonary gangrene. If the counteropening, in order to be effected, should demand perforation of a thick layer of pulmonary parenchyma, I think most surgeons would hesitate to prolong the operation on this account, for patients suffering from gangrene of the lung are, when operated upon, rather debilitated and exhausted. In my own case I felt like trusting to one opening, reserving the operation for a counteropening for some future time if necessity should call for one. Neither in Bull's case nor in mine did such a necessity arise.

I forgot to mention one point in connection with the thermocautery. A knife, trocar, or some blunt instrument may well be used for opening a cavity which is situated close to the surface of the lung; but in cases where any amount of parenchyma has to be perforated the thermocautery is by far the safer instrument. Now, I do not think it possible to ascertain by auscultation whether a few lines only or an inch or more of lung substance lie between the cavity and the wall of the thorax.

The cavity should be washed out with some antiseptic solution if practicable, but great care should be exercised in doing so. If the cavity communicates with a larger bronchus and we allow the solution to run in freely, we may, especially during the chloroform narcosis, be so unfortunate as to fill the bronchi of both lungs to such an extent as to produce suffocation. Moreover, injection of even a small quantity of fluid, the nature of which seems to be rather irrelevant, is, in some cases, followed by a fit of coughing sufficiently vehement to produce hemorrhage from the walls of the cavity. We should, therefore, allow a little fluid only, and that under low pressure, to run into the cavity at a time, and closely watch the effects thereby produced in the patient. It may be that simply draining the cavity without any washing out is sufficient to secure the beneficial effects of the operation. There is a great difference right here between Bull's case and mine. In Bull's case injection into the cavity never produced any coughing. In my case the smallest quantity of fluid, not only when injected under pressure, but also when allowed simply to flow into the wound with extreme gentleness, was immediately and invariably followed by violent coughing. Mosler, in treating other non-gangrenous cavities of the lungs, has experienced the same thing. He even attributed the death of one of his patients to the injection of a solution of thymol.

The wound may be dusted over with iodoform; this substance has proved effective in preventing the setting up of inflammatory disturbances by fetid fluid discharges coming into contact with the wound, as, for instance, in operations about the mouth and the rectum. But whether iodoform is indispensable in surgical cases of pulmonary gangrene is questionable. No case has as yet been reported in which the gangrenous fluid of a pulmonary cavity as such did much harm to the external wound; indeed, the fluid contained in these cavities does not seem to be septic.

A heavy antiseptic dressing should, of course, protect the wound. Septicemia or pyemia is just as likely to develop from a wound in the lung as from a wound in any other part of the body. But as it is difficult, nay, next to impossible, thoroughly to disinfect a pulmonary cavity, the consequences of sepsis would in these cases be disastrous.

After-treatment.—How often the dressings will require to be changed will be indicated by the amount of discharge found in them. In the beginning the wound will probably require dressing every day; later on, less often will be sufficient. Daily washing out of the cavity may be desirable, but does not seem to be essential. As mentioned above, it had probably better be omitted if followed by violent coughing. The internal treatment should be carried on in accordance with the principles commonly laid down for the treatment of the disease in question. Disinfecting or deodorizing inhalations, however, the influence of which it is difficult to comprehend from a rational *a priori* standpoint, seem to be rendered superfluous by the operation. If the canal should close before the cavity has cicatrized, I think we need not hesitate to remedy the matter by a second operation. In a favorable case the patient's general health will be far better than it was at the time of the first operation. As yet, however, no case has been published in which a second operation had become necessary.

In conclusion I shall repeat that, in my opinion, the above cases clearly prove the operation for acute, circumscribed, pulmonary gangrene to be a justifiable one. When performed in the above-described manner, it cannot be said to be attended with any immediate danger to life; moreover, when performed early, we may reasonably hope that it will not only afford temporary relief, but effect a permanent cure. I therefore think that this operation greatly deserves to receive the attention of the profession.

REMARKS ON THE OPERATION OF EXCISION OF HIP- AND KNEE-JOINTS, WITH EXHIBITION OF PATIENTS*

GENTLEMEN: I wish to present to the Society this afternoon a few patients on whom I performed, within the past four years, excisions either of the hip- or of the knee-joint. In doing so it cannot be my intention to discuss fully the subject of these operations: it is too comprehensive a one to be illustrated by a limited number of cases.

During the past ten years our knowledge of articular diseases has been greatly enriched by pathologic research, and, at the same time, the practice of joint surgery has undergone some modifications since the introduction of the antiseptic method. How far our expectations of the success of this method have been realized is a matter which admits of discussion. The cases which I wish to exhibit here are, of course, supposed to throw a little light on only a few points in this great question.

Let me first call your attention to the hip-joint. It is hardly necessary to point out to you that the old name, morbus coxarius, or caries of the hip-joint, is altogether too vague a term to be of any service, even to the practical surgeon. Suppurating synovitis of the hip, osteomyelitis of the head and neck of the femur, and tuberculosis of the hip-joint are to be distinguished from each other not merely because pathology shows them to be different diseases, but because these different diseases, if they are to be treated rationally, demand different modes of treatment.

By far the greater number of cases of morbus coxarius are cases of tuberculosis. It is still an open question whether the tuberculosis originates as a local osteotuberculosis in the head or neck of the femur or in the acetabulum, as Volkmann believes it to do in most cases, or whether it may not primarily be a tuberculous synovitis. But be this as it may, the knowledge of the fact that a primary osteotuberculosis often exists a long time without giving any symptoms of hip disease until, by opening into a joint, it causes a tuberculous destruction of the latter, has already had its beneficial application. Timely operations on the great trochanter have, by removing the local osteotuberculous focus, saved a number of joints from total destruction. As the hip-joint is covered by a thick mass of soft parts, it is materially much less accessible than the knee-joint. In hip cases an early diagnosis and treatment, by which the joint may be saved, will probably always remain exceptional. There is hardly a question in practical surgery which is more difficult to decide than whether and when, in a given case, a tuberculous hip-joint should be excised. Statistical tables, showing the mortality or the duration of the disease, teach us absolutely nothing in regard to this point, as in them mild and severe cases are promiscuously thrown together. Taylor gives a mortality of 12.5 per cent. in 288 cases treated without operation; 9 per cent. out of the 12 died of exhaustion and amyloid degeneration of various organs. Now, there is nothing in his tables to render it improbable that judicious operations would, in this instance, have depressed the death-rate to a still lower percentage—that they would have saved some of the 9 per cent. who died of exhaustion and amyloid degeneration. Lessing's excision statistics show a mortality of 64 per cent.; but as no distinction is made between early and late operations, they are far from proving that 36 per cent. of otherwise fatal cases of hip-joint were saved by the operation.

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* Read before the Illinois State Medical Society, 1884. Chicago Med. Jour. and Examiner, 1884, xlix, p. 289; Trans. Ill. State Med. Society, 1884, vol. xxxiv, p. 330.

In early excisions of the hip, that is, in those performed as soon as an abscess communicating with the joint has formed, and before the patient has become emaciated and exhausted by long-standing fever, the results of the operation are, so far as life is concerned, favorable enough; but we cannot do away with this objection to early excisions, that by them a healthy neck of the femur and trochanter are removed, which, if the abscess had been opened with antiseptic precautions, might have been saved and might have given the patient a more useful limb. On the other hand, if we wait until one or more abscesses have either broken or been opened with the knife, until, from failure of carefully and constantly applying antiseptic dressings to the discharging fistulas an exhausting fever, which in reality always means pyemia or septicemia, has established itself and reduced the patient's strength to a degree dangerous to life—if, I say, we wait until all this has taken place, then we run the risk of operating too late. The septicemia will probably progress in spite of the operation and the patient will die. By an early operation his life would probably have been saved. We are rendered unwilling to operate early, chiefly by consideration of the fact that in a great number of cases, where one or more abscesses had formed and been opened and running fistulas remained for a long time, the latter finally closed up spontaneously and the patients recovered, and this not so very rarely with a useful and even, to a certain extent, movable joint. Out of Gibney's 80 cases of spontaneous recovery, this occurred in 48.

In 1873 Volkmann, whom I consider to be the greatest now living authority on joint diseases, gave four indications for excision of the hip in cases of tuberculosis:

1. The presence of abscesses and fistulas with copious suppuration, together with a rise in temperature, which indicates that the patient's strength is beginning to be undermined.

2. High fever from acute suppuration in the articular capsule, coming on suddenly in the course of a chronic case.

3. An iliac abscess, which shows that the acetabulum has been perforated.

4. Established suppuration with dislocation of the head of the femur backward, so that it can be felt behind the acetabulum, covered by the gluteal muscles.

I think it safe to add a fifth indication—

5. Detachment of the epiphysis of the head of the femur and its lying in the articular capsule as a large sequestrum.

When Köster, Volkmann, Schüppel, and others discovered, in the course of their investigations, that fungoid arthritis or white swelling, and, consequently, the common form of morbus coxarius, was a local tuberculosis, this as such was for a time also looked upon as an indication for excision of the hip-joint. It was then thought that nothing short of an early removal of the miliary tubercles from the bone, the capsule, and the walls of the abscess cavities—if abscesses had already formed—could prevent a general and fatal tuberculous infection from spreading from the primary focus. It so happened that about the same time Lister gave his antiseptic method to the profession, and, as early operations were by this method deprived of their former danger to life, a number of early excisions of the hip were made. Six or eight years ago it was generally deemed justifiable to operate at the time of the formation of the first abscess—if possible, before it had opened. Surgeons had become hopeful. Lister's method seemed to secure here, as it does in other cases, healing by first intention, and the operation would eradicate the tuberculosis. Besides, matters seemed very much simplified as to recognizing the right moment when an operation becomes imperative, and expectant treatment is no longer permissible. Unfortunately, however, we were in this respect soon thrown into the old difficulties. It was found by all operators, I believe, but first expressly stated by König (in Langenbeck's Archiv, 1880, vol. xxv, p. 580), that healing by first intention, *i. e.* healing in four to eight weeks, still remained a very rare exception. An apparent healing would take place, but after a while new crops of miliary tubercles would grow up in the canals made by the drainage-tubes, or, in cases where the openings had closed, in the cicatrices left by them; new abscesses and ulcers would form. Moreover, it was learned that, notwithstanding early operations, about the usual 20 per cent. of these patients would, sooner or later, even after apparent cessation of the local process, succumb to tuberculosis of one or more of the internal organs. As pathology now began to rob this disease of some of its terrors, by demonstrating that, when local, it not so infrequently ended in recovery, pathologic researches concurred with surgical experience in bringing us back to our former more conservative standpoint regarding indications for excisions of the hip. We again shrink from the operation before the patient's life is threatened with danger, and are loth to take away living bone, which, after the termination of the disease, might help to form a solid ankylosis, or even a somewhat movable joint.

All of us, however, who have lived through this interesting period in the history of articular surgery will remember with pleasure that, in the great majority of these cases of early excisions, the after-treatment was much shorter than it had formerly ever been; the operation promptly and decidedly relieved the patient of his sufferings; the fever disappeared, and the malposition was corrected in a much shorter time than could ever have been done by conservative treatment. Unfortunately, we do not know whether the limbs resulting in the end from these operations were the best that could be obtained under the circumstances, or whether their function would not have been improved if the conservative treatment had been employed. We must confess that with regard to the whole question we are somewhat at sea. The final results of early operations and of conservative treatment are not sufficiently different to compel us to make one or the other the invariable rule in the treatment of tuberculous hip disease. In a given case we will, of course, always prefer conservative treatment, if by it we expect to obtain as good a result as by an operation.

Allow me first to present to you a few cases in which early operations were performed:

Case I.—Edward Prout, eight years old, was admitted to the Cook County Hospital on August 5, 1880. His parents were living, and both of them were in good health. A brother of his was at the time suffering from a tuberculous inflammation of a testicle following gonorrhea. Patient had always been in good health until three years and a half ago, when he fell from a swing, his right knee striking on a stone. About one month later he began to complain of pain in the knee. His right leg soon acquired a lameness which would come and go during the following year; the pain in the knee remained rather constant. About one year after receiving the injury he had a hip support put on by his physician, and extension made. His pain was thereby somewhat relieved. Patient wore the apparatus about three months; it was then taken off, as he was unable to pay for it.

Patient was now admitted to St. Luke's Hospital, and was thence, in the summer of 1878, taken to the Mercy Hospital. About one year later an abscess formed in Scarpa's triangle; an opening was made at the upper and inner part of the thigh, and the pus was evacuated; a sinus remained, which was still open at the time of the patient's admission to the County Hospital. A short time after the formation of this abscess a second one formed at the upper part of the posterior aspect of the thigh. This abscess, like the first one, was opened and left a fistula. In the beginning of 1880 the patient had apparently recovered. The affected limb had become about 1½ to 2 inches shorter than the sound one, but wearing a high-soled shoe on the foot of the diseased leg, he was able to walk on it. This condition continued up to the beginning of July, 1880, when the patient was kicked by a boy in the upper and posterior part of his right thigh, where a swelling, *i. e.*, an abscess, soon formed below the great trochanter. This abscess was opened, and a discharging sinus remained. Patient was now no longer able to walk; he complained of more or less pain all the time, and the three sinuses kept up a constant discharge; the thigh gradually became flexed.

An examination showed the boy to be rather pale and slim; there was no rise in temperature, but his pulse was a little accelerated—between 90 and 100. His lungs, heart, and urine were found to be normal. He could walk only with crutches, as he was prevented from putting his right foot to the ground by the adduction and flexion of his hip. There was 1½ inches shortening. The sinuses on the internal, posterior, and external aspects of the thigh discharged a moderate amount of pus. A probe introduced into the external sinus passed up behind the neck of the femur into the joint, where roughened bone was felt. Passive motion caused pain in the joint.

On August 20, 1880, an excision of the hip was made as follows: I made an incision anteriorly along the anterior sinus (Langenbeck's incision), with a view to removing the head of the femur only; but before getting into the joint a considerable venous hemorrhage occurred, the source of which was probably in the bulbous enlargement formed by the vena saphena magna just before joining the femoral vein. As it was impossible to stop this hemorrhage in the dense cicatricial tissue of the sinus otherwise than by ligation *en masse*, I had to give up the anterior incision. I therefore made the straight external incision over the outer side of the trochanter major, below which I sawed off the bone. As I operated subperiosteally, the cartilaginous portion of the trochanter major was left connected with the periosteum. The head of the femur had disappeared entirely, and the roughened end of the neck was found above and back of the acetabulum, which was covered with a thick, soft mass of tuberculous granulation tissue. I scraped the acetabulum, which was not perforated, with a gouge and the sharp spoon; the walls of the sinuses were likewise scraped. Drainage-tubes were then inserted in the three sinuses, and made to run up into the acetabulum. The lips of the wound were then united by sutures, and a Lister dressing applied. The limb was placed in an abducted position, a Verity splint put on, and extension, by means of a piece of rubber tubing and strips of adhesive plaster, made.

August 21st: During the after-treatment the evening temperature remained steady—in the neighborhood of 100° F.; only once did it rise to 100.5° F. Patient was free from pain, and commenced to eat toward the end of the first week. The wound, which healed by first intention and without suppuration, was dressed twice weekly. From the beginning of the third week the drainage-tubes were shortened every time the patient was dressed.

September 16th: Patient was able to draw his knee up a little.

September 18th: The last drainage-tube was removed.

September 20th: At this time, *i. e.*, four weeks after the operation, the wound had healed completely.

September 25th: The splint was taken off.

Patient was kept in bed two weeks longer; a high sole was placed under the foot of the sound limb, and he was allowed to walk with crutches.

A year ago an abscess formed behind the trochanter, which was opened, and then closed up in a few weeks.

He is now well nourished, and able to bear the whole weight of his body on the affected limb. There is little mobility in the newly formed joint, about 20 degrees flexion, no abduction or adduction nor rotation.

CASE II.—Fred. Hunneman, a child of healthy parents, began to limp when three and one-half years old. Extension by weight and pulley was tried during the first year of the disease. In its third year an abscess formed below the great trochanter; there was considerable pain in the joint, and he had some fever; his general health was impaired, and he was emaciated. The leg was flexed and adducted. Three and one-half years after the commencement of the disease—in February, 1881—I made an incision of the hip. After the operation the patient lay in bed eleven weeks, splinted and in extension. In six weeks the wound had healed up to the holes for the drainage-tubes. In fourteen weeks he was allowed to be up and about, having a plaster cast on the limb. There had been no fever nor drain after the operation, and his general health gradually improved. One year later, in January, 1882, an abscess formed below the gluteus maximus. On opening it it was found to be an intrapelvic abscess, which had formed subsequent to the perforation of the acetabulum. It had made its way out of the pelvis through the great sciatic notch along the pyriformis muscle. The walls of the abscess, within and without the pelvis, and the pelvic surface of the sciatic bone, were scraped with a sharp spoon. The wound healed in four to five weeks, a small fistula only remaining. Half a year later, in August, 1882, all fistulas had healed up definitively. Since that time the patient has walked about with crutches, having a high sole under the foot of the sound limb. He is in excellent health.

When allowed to try, it is seen that the affected limb is capable of bearing considerable weight.

CASE III.—John Prince. In the fall of 1877 he began to feel pain in his right knee, and later on in the thigh and groin. There had been no traumatic cause for the coming of this pain, which gradually became worse. He was disabled from walking without a cane and from sitting down, as he could not flex his thigh sufficiently. About Christmas, 1877, he fell on a stone sidewalk, striking on his hip, and the pain increased the following day. He then lay in bed, with extension on, for five months, but his condition remained about the same. On being so advised, he tried a portable extension apparatus, something like Taylor's machine. Four months subsequently an abscess formed on the outer aspect of the thigh; it was opened and left a fistula. In January, 1879, he entered the Cook County Hospital, was put to bed, and kept in extension for four months; he then got up and walked about with crutches and a high sole under the foot of the other leg. During the following three months the condition remained as it was, the fistula discharging considerably and tenderness existing around the joint. In September, 1879, I excised the joint below the lesser trochanter. During the fall and winter the patient had two attacks of erysipelas. He got up nine months subsequent to the operation, two years to his entering the hospital, and three and one-half years to the beginning of the disease. Since that time he has steadily improved. He has since picked up so much flesh that he is now almost twice as heavy as he ever was previous to or during his stay at the hospital. He walks easily with a cane; can bear the whole weight of the body on the limb operated upon. There is considerable active mobility in the newly formed joint, flexion 90 degrees, abduction and adduction 15 degrees, and considerable rotation.

In looking upon these as early operations we must bear in mind that discharging fistulas, abscesses, and, in two of the cases, some dislocation of the head of the femur, already existed. In the Hunneman case we were dealing with an acetabular coxitis, as was shown by the later formation of a pelvic abscess, which was scraped out and finally healed up. In this case, especially, the pain and fever were promptly relieved by the operation, and from the very day of its performance the local disease, as well as the general health of the patient, improved uninterruptedly.

A very extensive tuberculosis of the whole upper third of the femur induced me to make an excision of the hip in the following case:

CASE IV.—Thomas Hughes, aged sixteen, was admitted to the Cook County Hospital September 25, 1882. His parents were healthy; a brother of his, like himself, suffered from hip disease. *Four years previous* to his admission he began to feel some pain in his hip, groin, and thigh, and he acquired a slight limp. About the same time an abscess appeared on the dorsum of the foot; it was opened, and a chronic swelling remained, which finally led to the removal of the tuberculous first metatarsal bone. About one year later the patient fell, his hip striking on the floor. A swelling soon appeared in the neighborhood of the hip, and the patient complained of pain in the hip and in the knee. Several abscesses formed and were opened; sinuses remained, which alternately closed and opened, discharging at times considerable quantities of pus. Three months before the patient's admission three small pieces of bone were taken out of a fistulous opening in the groin.

On examination the leg was found to be flexed and adducted; as there was three inches of shortening, the foot did not reach the ground. The region of the hip was rounded and enlarged, and it presented one sinus anteriorly and three on the outer side. Passing the probe along these sinuses, I would feel roughened bone in the hip-joint, as well as on the trochanter major and the upper part of the shaft. The foot was deformed, as the removal of the first metatarsal bone had produced a retraction of the great toe.

On September 28th I excised the joint. The incision over the trochanter had to be prolonged downward over the upper third of the shaft of the femur. The head, trochanter, and 2½ inches of the shaft of the femur had to be removed. On examining the upper sawed end of the remaining shaft it was found thickened, and containing a tuberculous cavity. This was gouged out, and the diseased bone had to be chiseled away for a distance of 1½ inches, in order to reach healthy bony tissue. The preserved specimen shows considerable periosteal tuberculosis, with irregular periosteal exostoses, in which may be seen, here and there, the rounded cavities characteristic of local osteotuberculosis. I scraped the acetabulum and the walls of the existing sinuses, put in a sufficient number of large drainage-tubes, dusted the wound with iodoform, and closed it. A Lister dressing was applied, the limb placed in a Verity splint, and extension made.

Patient had been weak during the operation, and remained so for some time. There was considerable suppuration during the first month following the operation. The pulse-rate varied between 110 and 130, but the temperature never rose much above normal.

October 13th: A bed-sore formed over the sacrum, which grew larger for a couple of weeks; later on, bed-sores formed over the spinous processes of the lumbar vertebræ.

December 4th: The abdomen was greatly distended, as were also the superficial veins. Percussion showed the spleen to be enlarged considerably, and the dullness of the liver extended 6 inches below the ribs. Amyloid spleen and liver. The urine was clear and acid, and no albumin was detected in it.

January 21st: All bed-sores had healed.

February 1st: The splint was removed and patient was allowed to sit up and to walk about with crutches, wearing a high sole under the foot of the sound limb.

March 21st: Patient was dismissed from the hospital with an order to present himself once a week to have his limb dressed.

Patient is now robust, of healthy appearance, and the fistulas have been closed for half a year; he can bear the weight of his body on the limb operated upon; has active flexion of about 70 degrees; some abduction and adduction and some rotation.

The extent of active mobility patient has got in his hip is remarkable, considering the amount of bone removed. He can lift his leg and flex the thigh almost to a rectangle—to an angle of almost 90 degrees. This would be impossible if not a considerable reproduction of the bone had taken place, not only of the removed part of the shaft of the femur, but also, to some extent, of the great trochanter, for flexion is effected by the iliopsoas muscle.

In cases where the epiphysis of the head of the femur is detached and lies as a sequestrum in the acetabulum or in the abscess cavity surrounding the neck of the femur, there can be no doubt as to the propriety of an operation. However, in a given case of chronic hip disease the diagnosis of this detachment can, as a rule, not be made. There are no objective symptoms, so to speak, peculiar to this condition. As the detached epiphysis lies either in the acetabulum or is covered by a thick layer of soft parts, it cannot be felt. Unless the history of the case, together with the age of the patient, points toward such a condition,—*e. g.*, acute suppurative inflammation of the joint immediately following a fall on the great trochanter, or an acute suppurating osteomyelitis of the upper epiphysis of the femur,—the detachment will probably not be detected until the excision produces the necrotic head of the femur. This detachment is rarely met with in tuberculosis. An instance of this kind is the following case:

Case V.—Benjamin Cleaves, aged thirteen, was admitted to the Cook County Hospital August 21, 1883. There had been no consumption in his family, and he himself had always been healthy until, during the latter part of January, 1883, his left hip began to ache a little. As the inconvenience was slight, he paid no attention to it. One evening, while lying in bed, the pain became troublesome, and, in attempting to rise, he suddenly felt a sharp pang in the groin. The pain would return again and again until it finally became almost continuous. Three weeks after the commencement of the pain the patient had become obliged to pass most of his time sitting quietly in a chair. In March a physician was called, who advised the boy's parents to put him out into the country. In June an abscess on the outer side of the thigh was evacuated, and from the opening made pus continued to be discharged. No antiseptic dressings were applied. In July the patient returned to the city, and I saw him in the beginning of August. I found him lying in bed and very much emaciated; pulse, 124; temperature, 101.7° F. The right thigh was adducted and flexed; the slightest movement caused great pain in the hip and in the knee. The knee-joint was normal. During the night he would wake up and complain of severe pain in the hip. The region of the joint was rounded, swollen, and very tender to the touch. On the outer side of the thigh, 3 inches below the great trochanter, a fistulous opening discharged a considerable quantity of pus. Patient stated that he had never injured his hip, except two years ago, when, running along a stone wall, he struck against it with his hip, producing an abrasion of the skin. After this abrasion had healed he felt no pain for a year and a half afterward. The urine was normal.

August 23d: Excision of the hip. I made the usual straight incision over the great trochanter. A large cavity filled with pus and tuberculous granulation tissue was found to have formed around the great trochanter and the neck of the femur, which were to be removed. The necrosed epiphysis of the head of the femur was found detached in this cavity. The cartilage of the great trochanter was not removed. The walls of the cavity, the acetabulum, and the sinuses were scraped. It was all dusted over with iodoform and sufficient drainage provided for by several buttonhole openings, posterior laterally and external to the joint. An antiseptic dressing and a Verity splint were put on and extension made.

The wound discharged profusely. The evening temperature never sank below 101° or 102° F.; pulse always 120 or more. New pocketings of pus took place below the gluteal muscles. Bed-sores formed over the sacrum. In December pus was detected in the pelvis, burrowing along the iliacus muscle. A little later an incision was made in the lumbar region and a drainage-tube inserted. The injected fluid ran out at the opening in the thigh below Poupart's ligament. This large suppurating tract kept on discharging a great quantity of matter. Patient gradually lost strength, and died of pyemia January 8, 1884.

His case might be called one of early operation, if only the time from the beginning of the disease were to be considered. But the operation was made necessary by the profuse suppuration and septic fever, which, continuing in spite of the operation, caused the patient's death. Pyemia set in in this case, as no antiseptic precautions whatever had been observed at the opening and during the after-treatment of the abscess. In this connection I should like to mention a point regarding the influence the antiseptic method has had on the course of our treatment of this disease. *It is of the utmost importance, and should never be forgotten.* Just as the antiseptic method permitted us, at least for a time, to operate early as soon as the first abscess had formed, because by it the operation had been deprived of its great danger to patient's life, in the same way has the antiseptic method made it possible quietly to wait until the time for the late operation has come, without imperiling thereby the life of our patient, as was done formerly. The history of cold, that is, tuberculous abscesses, before and after the introduction of Lister's method, is too well known to require much discussion. It is true that, in former times, opening of a cold abscess was not invariably followed by septicemia. But it is also true that formerly opening of an abscess was always done at the risk of the patient's life, and no surgeon could avoid the danger. Now the patient's life is, in this respect, in the surgeon's hands; if a thoroughly antiseptic dressing be applied and kept over the opened abscess, we know that septicemia will not set in.

Late operations, aside from those cases which have progressed too far to be benefited by the surgeon, are preferable, as we ourselves are concerned, for we need not trouble our minds with the question whether excision had become a necessity or not. As regards the patient, he will, as a rule, have to go through a course of protracted and troublesome after-treatment; the limb may become unduly weakened, either from lack of growth on account of inactivity, or from secondary changes due to chronic inflammation or atrophy of the bones of the hip-joint, of the ilium as well as of the head of the femur.

In illustration of these two points I wish to present the following cases:

CASE VI.—Louis Anderson, aged nineteen, cigar-maker, was admitted to the hospital September 1, 1882. He had suffered for ten years from morbus coxarius of the right hip. A year or two after the beginning of the disease an abscess opened on the outer side of the joint; about four years later it closed again; it was followed by a second and a third abscess, which opened anteriorly and posteriorly and left discharging sinuses. Pain, shortening, and malposition rendered the limb entirely useless. On examining the patient I found the whole right lower extremity atrophied and much smaller than the other on account of retarded growth. Measurement showed the shortening to amount to 3½ inches; the limb was adducted and flexed; the trochanter was felt 1½ inches above Nélaton's line; but very little passive mobility remained. Pressure on the anterior part of the hip was painful. The knee presented a genu valgum or bow-leg, and the head of the fibula was apparently enlarged.

September 21st: The excision was made through the lower part of the great trochanter. The head of the femur and part of its neck had disappeared. A large abscess was found below the gluteus maximus, posterior to the acetabulum; it was opened, and its tuberculous walls were removed with the sharp spoon. The wound was closed and dressed in the same manner as in the above cases. During the first month of the after-treatment there was considerable discharge. The evening temperature would rise to 101° or 102° F., for a few weeks, but then it fell to normal.

December 13th: The drainage-tubes were removed. A large portion of the wound had not healed, but formed an open tuberculous ulcer.

About January 20, 1883, patient got an attack of erysipelas, which spread over the whole right leg. It subsided in two weeks.

February 18th: A peri-articular abscess, situated on the inner side of the knee, was opened.

In the beginning of April patient had a second attack of erysipelas, which lasted about one week. After patient had been in the hospital one year he was discharged, as he was able to walk about with the aid of crutches and a high sole under the foot of the sound leg. He still had large, granulating tuberculous sinuses.

The large granulating sinuses still remain, and will have to undergo further treatment of scraping and iodoform dressing. He can bear the weight of his body on the affected limb; there is only slight active mobility in the newly formed joint.

In this case the five or six years' duration of the disease had caused the growth of the whole extremity to be considerably retarded; besides, it had brought about a deformity of the knee, which in no small degree lessens the usefulness of the limb, and will probably do so for life.

The further disadvantages of a very late operation are well illustrated by Case VII:

Case VII.—Sina Anderson, aged twenty-one, single, daughter of a Nebraska farmer, was sent to the Cook County Hospital by me, and was admitted June 8, 1882. She was of a healthy family, and had herself been a healthy child. In her thirteenth year, eight years before the operation, she was suddenly seized with an acute bilateral inflammation of the hip-joints, which was mild on the right, but severe on the left, side. The right hip recovered completely within half a year, but in the left hip the inflammation terminated in an abscess, which was opened half a year after the commencement of the disease, and which had discharged pus ever since. Two years and a half before her admission to the hospital another abscess which had formed was opened, and a second fistula remained. In the beginning of the disease she had been confined to her bed for one and one-half years; after that time she could walk about with the aid of crutches. On account of the adduction and flexion of the thigh, which produced an apparent shortening of over 3 inches, she was at no time during those eight years able to use the affected limb in walking or to place its foot on the ground. During the whole period pain and discharge would both come and go. She was obliged to sit in a chair all day, as walking with crutches was very painful. On examination she was found to be well nourished, *i. e.*, not emaciated, but anemic. When standing, supported by crutches, she was unable to touch the ground with the toes of her left foot. The flexion and adduction of the affected limb had brought the left knee in a position anterior to and a little above the lower third of the right femur. The thigh and calf were atrophied; the latter was between 1 and 2 inches less in circumference than the calf of the sound leg. The soft tissues in the region of the hip had become hard from infiltration, and there was considerable enlargement and deformity. There was no active mobility in the joint; the slight passive movements which could be made produced severe pain. Three sinuses discharged from the thigh; one opened on the inner side, at the lower angle of Scarpa's triangle; another on the same level on the posterior side, and the third one on the outer side, below and behind the trochanter major. Every one of these three sinuses led the probe up in the direction of the joint, which, however, could not be reached. A fourth sinus opened in the lumbar region, just above the crest of the ilium. The probe passed down in the direction of the joint, but only for a short distance. An examination through the rectum revealed thickening of neither the os pubis nor the ischium. Pressure on the abdomen just above Poupart's ligament showed considerable thickening of the crest of the ilium, near its anterior-superior spine, and also of the ilium on its pelvic surface. This pressure, as well as all pressure in the neighborhood of the hip, was very painful.

Heart and lungs were normal, the liver of normal size, and the spleen not perceptibly enlarged. The urine was straw-colored, clear, acid, and contained neither albumin nor sugar. The diagnosis was morbus coxarius consequent upon acute osteomyelitis of the neck of the femur and suppurating synovitis.

January 20th: Pulse and temperature normal. Once in a while, however, the temperature would rise to 100° F.

January 21st: Operation. Assisted by Drs. Jacobson and Lee and the surgical house staff of the hospital I made an incision 10 inches long, in the line over the greater trochanter. I cut through the thickened soft tissues to a depth of over 2½ inches, and then reached a cavity filled with pus, and containing the detached epiphysis of the head of the femur. It was of normal shape, denuded of its cartilage, and the articular surface was superficially corroded near its border. The neck of the femur and the greater trochanter were still visible, but softened by fatty medullary atrophy to such an extent as to leave only a shell of bone as thin as paper surrounding the yellow, fatty, butter-like tissue of the marrow. The bone was sawed off below and close to the lesser trochanter. Here, also, there was only a thin shell of compact osseous substance left. After removal of the head of the femur and of the trochanter the leg could be abducted and extended. The pelvis was not touched; no sinuses were seen leading into the ilium. The four sinuses were now scraped, and each one received a drainage-tube. The cavity and the wound were dusted over with iodoform, the edges of the wound sewed together, and a Lister dressing and a Verity splint applied and elastic extension made.

The course of the after-treatment was normal, the patient's appetite fair, and scarcely any rise in temperature until October 25th, when it rose to 103° F.

October 25th: The wound was reopened and about two ounces of pus were evacuated from the old abscess cavity where the head of the femur had lain. The walls of the abscess cavity were scraped, and a counteropening was made through the gluteus maximus. Thereby the temperature was brought down again, and the course of the treatment ran on normally until November 23d, when a rise in temperature to 104° F. announced an attack of erysipelas. This lasted a couple of weeks, and left several small subcutaneous abscesses in the leg, which healed up toward the end of the year.

January, 1883: In January an abscess was opened on the outer side of the hip.

March 11th: The suspensory splint was removed.

April 22d: Extension was put on with a view to abduct the leg.

June 3d: One of the sinuses closed.

June 18th: Patient was anesthetized and the still open sinuses scraped with the sharp spoon. Several small fragments of necrosed bone were removed.

August 15th: The last fistula closed.

In September she was allowed to walk about supported by crutches and wearing a high sole under the foot of the healthy leg.

October 10th: She left the hospital for a private residence in the city.

During the winter of 1884 the sinus which had opened on the outer side of the hip and which had led up to the original abscess cavity reopened several times, discharged a little pus for a week or two, and then closed again. The leg gradually grew stronger. When lying in bed she could now, in April, 1884, raise the limb or draw up the knee to an angle of 20 to 30 degrees; when resting on the sound foot she had, in the hip-joint operated upon, 30 degrees of flexion, 10 degrees of abduction, and 10 degrees of adduction. The leg, which had become shortened by 2½ inches, was in good position; it could bear the weight of the body when she was allowed to try. She was well nourished, and not so pale as before the operation. The thickening of the soft parts around the hip was gradually subsiding; the thickening of the anterior part of the crest of the ilium, as well as that of the bone in the iliac fossa, is the same as before the operation.

She left the city with an apparatus somewhat like Taylor's, but provided with a flexible knee-joint. This apparatus enables her to walk comfortably with the aid of crutches.

In this instance the detachment of the epiphysis of the head of the femur could be suspected from the very beginning of the disease. The history provided sufficiently clear evidence, not of tuberculosis, but of suppurating coxitis, which would probably be osteomyelitis. Whenever, in a child, in the course of this disease, suppuration sets in and continues, with the formation of multiple abscesses, detachment of the epiphysis may always be inferred, and excision is indicated. If an early operation had been performed in this case, it is more than likely that no chronic osteoperiostitis of the ilium would have occurred, and the patient, besides being spared many years of suffering, would have recovered much more speedily after the operation.

Just here I should like to insert a few words concerning a peculiar form of atrophy of bone which is found in some cases where there is long-standing suppuration in close proximity to osseous tissue. We should be well acquainted with the matter, as it is of no mean practical importance at the time of operating. In this peculiar form of atrophy, which is especially met with in the near neighborhood of suppurating joints, the osseous substance, cancellous as well as compact, is absorbed, and its space is occupied by a fatty, infiltrated marrow. This marrow is poor in vessels, of soft consistence, and bright yellow in color; it somewhat resembles butter. The bone proper is reduced to a mere shell, here and there as thin as paper, and, on account of its thinness, of an elastic feel. Such bone is, of course, useless, but it is very important to remember that this kind of atrophy is altogether unlike an inflammatory destructive process. This medullary tissue of the bones, whether young or old, red or yellow and fatty, is always capable of producing new osseous substance. That formation of new bone does take place in this marrow after the operation is well known, especially from cases of excision of the knee. The bones left in this condition of atrophy soon acquired sufficient firmness to bear the weight of the body. We must, therefore, not be misled by this atrophic appearance into removing more of the bone than we should do if we saw firm osseous substance before us. The limb of the patient whom I have just shown you is now, one and one-half years since excision was made, strong enough to bear considerable weight.

Finally, I wish to mention a case where the operation was performed too late:

CASE VIII.—Patient was a boy of twelve years, pale and lean. There were several fistulas, which discharged considerably; the leg was in a position of adduction and flexion. The disease had lasted four years. There was no fever, no tuberculosis of the lungs, no albuminuria. Patient had been in bed for over a year, and his appetite was exceedingly poor. Excision was made, unaccompanied by any complicating accident. There was no unusual vomiting subsequent to the narcosis, nor were any signs of carbolic acid poisoning to be detected in the urine. But patient gradually sank after the operation. His pulse remained 100; his temperature never rose above normal. Eleven days after the operation he died. The autopsy revealed no disease of any of the internal organs, no tuberculosis, and no amyloid degeneration. But the whole body was in a condition of extreme anemia. The wound had not suppurated, and was apparently on the way to healing by first intention.

Before concluding my remarks on hip operations I wish to repeat that excision of the hip-joint in a chronic case of hip disease, and performed with observation of antiseptic precautions, is by no means a dangerous operation. The hemorrhage is trifling, and the shock moderate. The danger of former times, those of a supervening septicemia, or, as it is often called, especially by English writers, of exhaustion or exhaustive suppuration, it is at the present time in the power of the surgeon to exclude almost to a certainty. Fear of cutting short the patient's life is, consequently, no longer a strong reason for postponing the operation. On the other hand, if the operation be deferred too long, that is, until septicemia has established itself, the patient will die in spite of the operation. The main question to be decided in early operations does not refer to the life of the patient, but to the removal of living bone, which, later on, might become serviceable in supporting the body. Gouging out of the hip-joint is technically impracticable; the attempts made have not given satisfactory results. Partial excisions, excisions of the diseased head alone, leaving part of the neck of the femur and the trochanter in place, have been tried, but again abandoned. As complete excision, through or below the great trochanter, is thus the only advisable form of the operation, the question, when should we operate, still presents the greatest difficulties in the solution of the whole problem.

Excision of the Knee-joint.—What was said of the tuberculous infection when speaking of the hip-joint, of course, finds application here also. The results obtained by antiseptic surgery of the knee are excellent. The wounds heal speedily, and the danger to life is small. The death-rate has been reduced from about 30 per cent. to almost a trifling percentage. In a series of 32 excisions of the knee made by Volkmann there occurred not one death attributable to the operation. In excising a knee-joint we have an additional object in view, which plays no part in operations upon the hip, namely, we try to make the cut surfaces of the femur and tibia grow together and to produce a solid ankylosis. The surfaces of the two bones should be cut in such a way as to secure a good position of the leg afterward; they can easily be kept in apposition by means of wires, pins, or nails. In a number of cases the bones unite in the course of a few weeks, the time in which we expect to get a union in cases of subcutaneous fractures. Such a case is the following:

CASE I.—James Carr, fifteen years old, entered Cook County Hospital in July, 1879. He suffered from tuberculous arthritis of two years' standing. The leg was flexed to a right angle, the region of the joint was swollen and tender, and on each side there were scars from closed sinuses consequent upon abscesses. Excision was performed August 6th. In three weeks a solid osseous union had taken place; in five weeks he was up and walked about with crutches. Ten weeks after the operation he was able to walk without the use of either crutch or cane. In the course of the following half year tubercular abscesses and sinuses formed in different places in the cicatrix of the excision wound. Scraping and iodoform treatment caused these abscesses to close up definitively; their formation never interfered with the solid osseous union of the two bones.

There is now a solid ankylosis in a straight position; he is able to walk all day long and perform any kind of work, without having any pain in the leg whatever.*

This case, furthermore, illustrates that a secondary local growth of tubercles in and around the cicatrix does not necessarily destroy the effects of the operation, as far as a permanent cure and perfect usefulness of the limb are concerned.

In excisions of the knee-joint, where alone we desire to obtain a good solid ankylosis, we encounter a peculiar difficulty, and that is, that wè by no means always get a good solid ankylosis. For reasons not well understood the bones do not grow together, but are held in union by more or less ligamentous tissue. This seems to happen more frequently in children than in adults. In these cases it does not always become apparent at once that the function of the limb will be destroyed. A shorter or longer time after the operation the limb, which at first was in a good straight position, has become a little retracted or flexed, the degree of flexion grows worse, until finally a contracture is developed. In some instances this contracture will begin to come on during the early part of the convalescence; in others the patient will get up, walk about with an apparently solid ankylosis, the leg will be in good position, and we may congratulate ourselves upon the good results of the operation. But it is too early. One, two, or three years later the contracture of the knee may begin. This contracture may, to a certain extent, be combated by immobilizing apparatus. Our patient should always be made aware of the probability of its occurrence. In adults immobilizing apparatus put on timely, that is, as soon as any liability to contracture becomes apparent, may prevent the contracture from developing to such a degree as to interfere very much with the use of the limb. The matter is difficult in cases of small children. Not only is the liability to contracture here greater, but all experienced surgeons know that it is difficult and oftentimes altogether impossible to keep immobilizing bandages or apparatus on these little patients for a sufficient length of time, and with a sufficient degree of immobility, to prevent secondary contractures from coming on. Sometimes the apparatus produces pain, and cannot be borne on that account. Extension by weight and pulleys cannot be continued sufficiently long, for these little ones will get up and walk about. Small children cannot be taught to use crutches as efficiently as older ones can. They will step on the foot unless prevented by severe pain. The consequence of all this is that in these cases nothing can be done to ward off the contracture. One or two years after the operation we often find the leg forming a rectangle with the thigh; the malposition is as bad as it was before the excision. There is, however, this difference between the two conditions, that now the white swelling or tuberculosis is gone, the fistulas have healed, and the joint is neither tender nor painful. The only but great trouble that remains is that the limb is almost useless for walking purposes.

I have two cases in point here, and will show them to you:

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* This case was published *in extenso* in a former paper by me, printed in the Chicago Medical Journal and Examiner in July, 1880.

Case II.—William Kane, nine years old, was admitted to the Cook County Hospital September 6, 1880. His family history told of no cases of tuberculosis; he had two brothers and two sisters living and healthy. Two and one-half years previous to his admission he had jumped off an ice-box and injured his knee. Soon afterward the knee became swollen and painful. After hot applications had been made for two weeks the swelling was lanced and exit given to half a pint of matter. Poultices were then applied, and the discharge continued. Three months later another abscess was lanced on the inner side of the knee and 5 to 6 ounces of pus evacuated. During the following four months several new abscesses formed along the tibia. He further stated that there had been 11 sinuses, and that at one time they were all discharging. Those on the leg closed in May, 1880. Patient was very low a year before the date of his admission; his death was then expected every hour, and he wasted away to such an extent that, as his father said, nothing seemed to be left of him but skin and bones. In April, 1880, his health began to improve and some of the sinuses closed. At the time of his admission his general health was fair; he was fairly well nourished, had a good appetite, and slept well. The right knee presented a deformity, the tibia being dislocated backward, thereby producing an eversion of the foot. The anterior surface of the knee showed a running fistula. Along the inner side of the leg the marks of several closed sinuses were to be seen. The leg was drawn up almost to a right angle, and there was but a minimum of motion left in the joint. Pressure upon the knee was not painful. Patient managed to walk about with the aid of crutches.

September 17th: Excision of the knee-joint. A horseshoe-shaped incision was made below the patella, and the patella removed. The condyles of the femur were sawed off close to the line of the joint. The external condyle had almost entirely disappeared. The internal condyle formed the inner termination of the sinus, which opened at the anterior inner part of the knee. One-sixth of an inch of the tibia was removed, and the sawn surfaces of the femur and tibia united and held together with two pieces of silver wire. Drainage-tubes were introduced and placed before and behind the bone; the wound was closed, and an antiseptic dressing applied. The leg was placed in a straight tin splint with side doors, and then suspended from a frame.

September 19th: Temperature, 102° F.

September 22d: The leg was dressed; a moderate discharge of pus was found.

September 24th: Temperature, 101.5° F. The wound was dressed daily; the discharge had a perceptible odor.

September 25th: An abscess which had formed near the head of the fibula was opened and gave exit to ½ ounce of pus. In the course of the following week several abscesses formed along the tibia, at the places where the old sinuses had been. They were opened and drained one after the other. In the beginning of October the temperature returned to normal. Two weeks later the discharge stopped, and the femur and tibia had become somewhat united. About the middle of October the wound and all the sinuses had healed up, and the splint was removed.

Patient was dismissed with the advice to use crutches in walking and to keep the foot of the diseased leg from the ground. The bony union had not yet grown sufficiently firm, and the limb showed some tendency to flexion.

At the present time the leg is flexed at the knee to a right angle; there is no sinus, no swelling, no tenderness, but a solid osseous union between the cut surfaces of the bones did not take place, and we detect a slight mobility on making forcible flexion and extension.

Case III.—John Hostetter, aged six, fell when one year old. A tuberculosis of the knee-joint ensued, and in the course of the following three years abscesses formed and kept discharging. A contraction beyond a right angle, together with dislocation of the head of the tibia backward on to the posterior surface of the condyles of the femur, gradually developed. Two years ago there was an ulcerated surface over the internal condyle of the femur of over an inch in diameter, the bottom of which was formed by the denuded bone. At that time, two years ago, I made the excision; wound and sinuses healed in a couple of months. No perfect osseous union took place. In the course of half a year a contraction to a right angle had been formed. Now there is neither tenderness nor swelling in the region of the joint nor any open sinuses, but the leg is flexed to a right angle. He limps about without having any pain, but is greatly inconvenienced by the deformity.

In these two little patients surgical procedures, forcible stretching or neiform osteotomy, will be necessary to procure a straight position of the limbs. In that respect the operations may be said to have failed of accomplishing their objects. It would, however, be going a little too far to assert that in these two cases the operations were entirely useless. In both cases the local tuberculous inflammation, with its attending pain and debilitating effects on the general health, was successfully checked. Besides, as these patients are always able to use the limb somewhat, the atrophy of inactivity, the retarded growth of the leg and foot, is considerably helped by the operation. This is the more important the younger the child is, as in young children growth is most energetic.

Volkmann proposed a new method of operating in these cases. He makes a transverse incision and then bisects the patella. Primary union of the patella may always be expected to take place in an aseptic case. Whether such operations will be followed by contractions or not is a question which the future will have to answer. Older statistics, to be sure, show a greater mortality in cases where the patella was allowed to remain than where it was removed. But this does not constitute an objection to Volkmann's operation, for, armed as we are with the antiseptic method, we no longer fear such dangers as might threaten from a remaining patella.

As we have seen, there is one great imperfection in the results of excision of tuberculous knee-joints. Nevertheless, I feel justified in asserting that, in almost all cases of white swelling or tuberculosis of the knee, an attempt should be made to save the limb by conservative surgery, by gouging out the tuberculous joint, or by an excision of the same, and that amputation of a limb in a case of white swelling, without such previous attempt, should become one of the rarest exceptions.

CHRONIC PERI-UTERINE ABSCESS AND ITS TREATMENT BY LAPAROTOMY *

A PERI-UTERINE abscess of the broad ligament, or parametritic abscess, is the result of an inflammation in the connective tissue surrounding the uterus. This inflammation is always caused by invasion of septic material from an injured place in the mucous membrane of the female genital tract. A septic lymphangitis (Mundé†) or phlebitis will here, as anywhere else in the body, be the initial stage. If this septic invasion happens to strike a preformed uterine hematocele, it finds fertile soil for development, and consequent transformation of the hematocele into an abscess. If there is no preformed hematocele, then the loose connective tissue of the lateral ligament—where an edema may be easily developed with its exudation of serous fluid—furnishes a soil as well adapted to the cultivation of the septic microbes as the blood in the hematocele. Both this serous exudate and blood of the hematocele give the same facilities for development as the fluids in the glasses in the experimental laboratories.

The parametritis of Virchow or pelvic cellulitis of Barnes‡ is consequently of very common occurrence, and although this inflammation takes a light and benignant course in the majority of cases, yet it may lead to the most grave and difficult cases with which the surgeon has to deal. I have never seen this better expressed than in the words of Emmet, who says:§ "I do not exaggerate when I claim that pelvic cellulitis is by far the most important form of pelvic inflammation with which woman is afflicted."

This suppurating parametritis, whether connected with the puerperium or not, may, like lymphangitis or phlebitis in other parts of the body, lead to the formation of abscesses not only at the point of invasion, but also in more remote parts, probably from suppurating lymph-glands. Only in this way can we account for the fact that in a number of the parametritides, especially in those connected with the puerperium, the abscess often forms in the loose retroperitoneal tissue of the iliac fossa, and can be opened by an extraperitoneal operation, either at Poupart's ligament or at any place along the brim of the pelvis. This form of suppuration takes, almost always, an acute course, while if the abscess is formed in the uterine half of the broad ligament, or in the

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* Ann. Surgery, 1885, vol. i, p. 393.

† Amer. Jour. Obstet., October, 1883, vol. xvi, p. 1009.

‡ Clinical History of the Medical and Surgical Diseases of Women, London, 1873.

§ Principles and Practice of Gynecology, 1879, p. 258.

antero-uterine or retro-uterine connective tissue, it is more apt to take a chronic course, as a considerable thickening of the connective tissue surrounding the pus is apt to take place, and, so to speak, encapsulates the abscess.

I shall limit my remarks to the latter form of pelvic abscess, in the locality immediately surrounding the uterus, where Sinety* describes his "*inflammation circum-uterine proprement dite.*"

An abscess in this place is apt to perforate into the rectum or bladder or into some part of the genital tract, usually into the vagina.

In a number of cases the evacuation of the abscess, whether spontaneous or artificial, will be followed by retraction of the abscess wall and cure; but there remain some cases in which the abscess does not close. Whether insufficient outlet or invasion of new septic material from the perforation opening causes the abscess to continue is immaterial; the fact remains that a number of such cases exist, and that if not overcome by surgical treatment, the patient's life will slowly but surely be destroyed in one of the following ways:† The continued septic inflammation in the cavity will cause chronic septicemia and destroy life under the symptoms of so-called hectic fever;‡ amyloid degeneration of the spleen, kidneys, and liver will cause the patient to die under the symptoms of hydrops and uremia; more rarely, it may be, according to the general opinion of authors (Schroeder and others), a tuberculosis will develop secondarily in the abscess wall (I am more inclined to believe, however, that such an abscess is a tuberculosis from the beginning); finally an acute gangrenous septic inflammation may set in in the cavity and cause death in a very short time under the symptoms of an acute typhoid condition.

Considering the grave prognosis of chronic peri-uterine abscess, whether it has an outlet or not, we are justified in resorting to even the most serious surgical procedures to prevent the otherwise certain fatal termination.

There are two ways in which such an abscess may be attacked with a view to effect free opening, drainage, and washing out from the vagina or from above the pubes, with or without opening the abdominal cavity.

Schroeder§ advocates the operation through the vagina, even in cases where the abscess does not point in this direction, and where it has opened into the rectum; he cuts through the vagina in the lacunar, and dissects up along the uterus, keeping close to the latter until the abscess is reached.

From above the pubes the abscess can be reached when it has perforated into the bladder by opening into the latter by the sectio alta, as performed by Schroeder.*

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* Progrès Médicale, 1882, vol. x, pp. 591 and 611; Virchow-Hirsch's Jahresbericht, 1883, vol. ii, p. 530.

† Schroeder: "Krankheiten der weiblichen Geschlechtsorgane," Ziemssen's Handbuch der speciellen Pathologie und Therapie.

‡ Schroeder: *Ibid.*

§ Zeitschr. f. Geb. und Gyn., 1882, vol. viii, p. 120; Virchow-Hirsch Jahresbericht, 1883, vol. ii, p. 530.

In the rather rare cases in which an ante-uterine abscess has pressed the pubic fold of the peritoneum upward toward the umbilicus the abscess can be reached by an incision in the median line above the bladder.

The most important and effectual operation for chronic peri-uterine abscess, namely, attacking the abscess through the abdominal cavity by means of laparotomy, we owe to Lawson Tait.† Occasionally, in former years, it happened that a large peri-uterine abscess that had been mistaken for an ovarian tumor or a uterine fibroid was cut down upon by laparotomy, opened and evacuated, and, as extirpation of the sac, as a matter of course, was an impossibility, the walls of the sac were united with the abdominal wound, and quite a number of these cases recovered. But Lawson Tait has the merit of being the first man who, with full knowledge of the diagnosis, systematically made use of laparotomy to bring such cases to a successful termination, and he is able now, in 1885, to report as many as 30 cases of such operations without a single death.‡

Before attempting to discuss the relative value of the different operations mentioned above, and before entering into the details of the operative procedure, I shall report the following 3 cases of chronic peri-uterine abscess communicating with the rectum which have come under my observation during the last two years, and which I have treated by laparotomy:

CASE I.—*Chronic tuberculosis of right broad ligament. Tuberculous abscess communicating with rectum of nine months' standing. Intermittent discharges through the rectum and intermittent attacks of fever. Great emaciation. Laparotomy. Sac united with abdominal wound. Two ounces of tuberculous tissue removed from cavity. Remainder of tuberculous contents destroyed by caustic potash. Recovery from operation. Small recto-abdominal fistula remaining. Death sixteen months later, under symptoms of chronic ulcerating tuberculosis of intestinal canal. No autopsy.*

In March, 1883, I was called by Dr. T. S. Bidwell to see Mrs. O. I am indebted to Dr. Bidwell for the following previous history of the case:

The patient is twenty-seven years of age. She was married in 1879. Six months later she had an attack of what seemed to be severe pelvic cellulitis, which lasted for several weeks, but subsided under rest and treatment. On examination at this time the uterus was found to be fixed, painful to the touch, as if bound down by adhesions, and a little lower down than normal. The uterus remained immovable after the subsidence of the cellulitis. In July, 1880, she was taken with bowel and stomach trouble, with severe pain in the inguinal regions, vomiting and diarrhea, which lasted for several weeks. She was fairly well during 1881 and the spring of 1882. In the latter part of 1882, however, she had considerable severe pain in the bowels, followed by a discharge of pus from the rectum.

On examination a tumor was found in the abdomen, a little to the right of the median line, just below the umbilicus. The tumor was about the size of the fist, hard, immovable, and painful on pressure. It was supposed that the patient was suffering from pelvic cellulitis, and that a pelvic abscess had been formed which had opened into the rectum. On rectal examination, however, no opening could be found. The discharge of pus from the rectum has continued, from time to time, until now. During the winter of 1882 she had a severe fit of sickness, resembling typhoid, with morning and evening temperature, pains in the abdomen, diarrhea, and discharge of pus from the rectum, from which she recovered in about three weeks.

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* *Op. cit.*

† Pathology and Treatment of Diseases of the Ovaries, 1883, p. 344.

‡ Medical Record, 1885, vol. xxiii, p. 1.

On examination I found the patient considerably emaciated; pulse, 100; temperature, 101° F. She complained of pains in the lower part of the abdomen when walking, and stated that once in every two or three weeks the pain increased, accompanied by more fever than usual, and, after this condition had lasted for about a week, there would be a considerable discharge of pus from the rectum, followed by relief from the pain and fever. Heart and lungs, normal; abdomen not enlarged. In the suprapubic region was an immovable tumor, about the size of the fist, in the median line, extending a little farther to the right than to the left side. On vaginal examination I found the uterus immovable, the vaginal portion pressed to the left side, and firmly connected with a hard tumor in the region of the right broad ligament. It was impossible exactly to define the limits of the uterus, as it formed, with the tumor, one immovable mass. On rectal examination the tumor could be felt to the right of and behind the vaginal portion, but no perforation opening into the rectum could be reached. The patient complained of constant diarrhea, accompanied by griping pains preceding defecation.

Diagnosis.—Peri-uterine abscess in right broad ligament, communicating with rectum. As there was no place in the vagina where any soft part or anything like fluctuation could be felt, I decided to perform laparotomy, with a view to draining the abscess, and, if possible, closing up the cavity.

July 10th, assisted by Drs. Bidwell, Lachmann, Verity, and others, I proceeded to the operation. After the usual preparations for laparotomy the patient was anesthetized, and an incision made in the median line, from 1 inch above the symphysis to 2 inches below the umbilicus. When the peritoneal cavity had been opened, a round, red tumor, covered with peritoneum, presented itself in the median line. It was 3 inches broad, 3 inches high, and was surrounded by closely adherent intestines and omentum, hard to the touch, having no fluctuating or soft parts. The Fallopian tubes and the ovaries could be neither felt nor seen, and a gynecologist present stated, as his opinion, that the tumor was an enlarged uterus, and that there was no abscess. The needle of a hypodermic syringe was introduced in several places, but blood, and no pus, was withdrawn into the syringe. Having thus failed to find the abscess, I endeavored, by moving the needle in various directions, to find a cavity, empty, of course, but in which I could move the needle around. Finally I thought I had discovered such a cavity, and so cut in on the needle. The knife passed through a thick layer of firm, elastic connective tissue, and finally penetrated a cavity, from which a few drops of grayish pus came out. When this opening had been dilated sufficiently to admit the finger, I could feel a cavity filled with a cauliflower-like mass of friable tissue, in the midst of which was a canal; through this canal the finger passed down into the rectum, meeting the finger of one of the gentlemen present, which had been introduced through the anus. I then enlarged the opening, and saw a large cavity filled with irregular masses of friable, grayish-red tissue, bleeding only a little on pressure, and resembling the irregular surface of a sarcomatous tumor. I really considered the case to be one of malignant tumor, and that its entire removal was impossible. At the same time I decided to scrape out as much of this mass as I conveniently could, and so removed, with the sharp spoon, about two ounces of the grayish, somewhat friable substance. The cavity then presented rather grayish walls, from which there was only slight hemorrhage, and at the bottom of which was seen an opening, sufficient for the passage of two fingers, leading to the rectum.

The walls of the cavity were disinfected with 10 per cent. solution of chlorid of zinc; the walls of the sac united with the lower end of the abdominal wound by means of a double row of sutures, and the remainder of the abdominal wound closed. A heavy drainage-tube was inserted into the cavity, and the cavity around the tube packed with iodoform gauze. A heavy antiseptic dressing was now applied, and the patient brought to bed, the operation having lasted two hours and a half.

At this time, as I considered the case one of malignant tumor and consequently hopeless, my only aim was to have the patient recover from the effects of the operation, as I did not believe that any further treatment would be called for.

July 11th: The patient has passed a rather comfortable night. Pulse, 114; temperature, 98° F. The dressings, when removed, are found soiled with liquid feces all over the abdominal wound, which was cleaned, powdered with iodoform, and redressed. Over the os sacrum is a decubitus eschar the size of a dollar.

Concerning the rest of the after-treatment, it is sufficient to say that the dressings each day were found soiled with liquid feces. The abdominal wound healed without suppuration and without any disturbance whatever from the side of the peritoneal cavity. A microscopic examination of the cauliflower-like tissue removed demonstrated, contrary to my expectations, that this tissue was not a sarcoma, but conglomerate masses of miliary tubercles. The disease thus being proved a local tuberculosis, and consequently not necessarily fatal, made it important to attempt to destroy all the tuberculous tissue, so that the cavity might finally close up. To effect this the following plan of local treatment was carried out: Once every day, or every two days, the mass of grayish tissue was cauterized by Dr. Bidwell with caustic potash. After this had been done for about two weeks the cavity was cleared of its contents and commenced to retract, and bimanual examination showed that not more of the hard mass remained than what would correspond to a slightly enlarged uterus.

On the tenth day the sutures of the abdominal wound were removed. In the third week the patient was able to sit up in bed, and a week later could sit up in a chair, the bed-sore over the sacrum being the only obstacle in the way of her recovery from the operation. The drainage-tube in the cavity was now removed. From the fistulous opening a small amount of fecal matter would still come, especially when the bowels were loose. In the sixth week she was able to walk about, had a good appetite, and daily became stronger, but the bed-sore did not entirely heal up until about three months after the operation.

The patient's condition remained about the same from this time on. She suffered from diarrhea and pain in the intestines all the time. About twelve months after the operation the pain and diarrhea became more severe, the patient's emaciation increased, and four months later she died. No autopsy was made.

It is impossible for me to state whether this tuberculous abscess cavity was a tuberculosis developed in the Fallopian tube, or in a periuterine abscess outside of the tube. That the tissue removed from the abscess was a conglomeration of miliary tubercles was easily enough demonstrated by the microscope; but in most of these cases, so far as my experience goes, the tubes and ovaries are matted together with the uterus and adjacent intestines into one mass, in which it is impossible to distinguish the different organs—in many cases even to determine which is the uterus and which the cavity before the latter has been cut into. But tuberculosis of the tubes is much more common than tuberculosis of an extra-tubal pelvic abscess wall, as we know that the mucous membrane of the uterus and tubes is quite commonly the starting-point of infiltrating tuberculosis.

In cases of this kind we cannot, of course, expect the operation to be a radical cure, as it is almost impossible to remove all the tuberculous tissue. Even if this could be accomplished, we know that of the patients with local tuberculosis, even if successfully operated upon, a large percentage—in local tuberculosis of the joints 25 per cent.—will succumb sooner or later to either acute or chronic general tuberculosis of the internal organs. That this patient died sixteen months after the operation from intestinal tuberculosis there can be very little doubt, although no autopsy was made, as she suffered all the time from chronic diarrhea with pain in the intestines and increasing emaciation, with no symptoms of serious disease either of the kidneys or of the organs of the thoracic cavity.

This was an unusual form of infiltrated tuberculosis,—one that I had never before seen,—as there was no cheesy matter in the abscess cavity, but it was filled with a voluminous proliferating mass of grayish-red living tissue, resembling rather a cauliflower form of carcinoma or sarcoma than tuberculosis.

The rapid formation of a large bed-sore proved that the patient was already in an extremely exhausted condition from the chronic septic fever. A rather remarkable feature in the course of the after-treatment was that the abdominal wound healed by first intention, notwithstanding that from the very day of the operation it was continually covered with fecal matter. I believe that the treatment of the wound with iodoform protected it against the feces.

The necessity of early operation before a chronic abscess of this kind has had time to cause amyloid degeneration of the internal organs, and so to frustrate any surgical effort at a cure, is well illustrated by the following case:

Case II.—*Chronic peri-uterine abscess in left broad ligament, communicating with rectum, of more than a year's standing. Intermittent discharge through rectum. Chronic septicemia, albuminuria, commencing anasarca. Laparotomy, with union of sac to abdominal wound. Reopening of abdominal wound and evacuation of four ounces of bloody serum. Death, nine days after operation, from uremia. Autopsy. Amyloid degeneration of spleen and kidneys.*

Margaret Robinson, thirty-eight years of age, domestic, entered Cook County Hospital September 12, 1884. Family history good. Parents died in old age. Patient was married in 1872. Since that time has been troubled with uterine disease, but was otherwise healthy. Her menstrual periods commenced at fifteen and have been always regular, recurring every three weeks, but the flow has been always copious and painful. She has never had any children or miscarriages. Her present disease began in June, 1883, with pain in the suprapubic region and fever, so that she was obliged to remain in bed for several weeks, after which a sudden discharge of pus through the rectum partially relieved the pain. She was told by her doctor that she had a pelvic abscess which had broken into the rectum. She soon was able to be up and around, but was unable to do any work because of the pain and discharge of pus through the rectum, sometimes continual, sometimes intermittent, which would result from any such attempt.

During the last year she has grown weaker, and a month ago her feet began to swell at the ankles. Since this time the pain over the symphysis and os sacrum has been almost constant; the passages from the bowels have caused pain high up in the rectum; she has had fever almost every day, and occasional chills and headache. Her appetite is poor, and she has grown weaker every day. Pulse, 120; temperature, 102.6° F. Ordered quinin; rectum to be washed out daily with lukewarm water.

September 13th, A. M.: Pulse, 102; temperature, 101.2° F. P. M.: Pulse, 138; temperature, 103.5° F. On examination we find patient pale, not extremely emaciated; slight edema round the ankles; heart and lungs normal. Vaginal examination shows the uterus pressed forward and to the right—immovable. In left lateral ligament is a hard swelling close to the side of the uterus, and somewhat tender on pressure. In the suprapubic region is a hard swelling 3 inches broad, extending to midway between the symphysis and umbilicus. Digital exploration through the rectum shows the tumor high up and to the left of the uterus. As high up as the finger can reach—that is, 3 or 4 inches above the anus—can be felt a hard, nodulated place in the rectum, which is probably the perforating opening surrounded by granulations. Urine acid, amber colored, containing some albumin and casts.

Diagnosis.—Abscess in left broad ligament, communicating with the rectum. Commencing septicemia, albuminuria, and anasarca.

It was decided to open the abscess by laparotomy.

September 16th, 10.30 A. M.: Assisted by Drs. Guerin, Jacobson, Murphy, Verity, and Randall, of the hospital staff, and house surgeons Thiele and Auten, I proceeded to the operation. After the usual preparations for laparotomy the patient was anesthetized. The pubes were shaved, and the vagina washed out with 2.5 per cent. solution of carbolic acid. I then made an incision in the median line, from 1 inch above the symphysis pubis to 2 inches below the umbilicus. When the abdominal cavity had been opened, a dark-red tumor, smooth and covered with peritoneum, was disclosed. It was round, about 3 inches high, and extended from a little above the symphysis to about 2 inches below the umbilicus, the left side being united with the sigmoid flexure. The needle of a small exploring syringe was now introduced into the tumor, but no pus could be withdrawn. On the withdrawal of the needle, however, a drop of pus came out at the opening. Antiseptic sponges were now packed around the tumor in the abdominal cavity, and an incision made through the wall of the sac. Several ounces of very fetid pus came out through the opening, whereupon the incision was enlarged, the edges seized with strong forceps, and sponges introduced to clean the cavity. A probe introduced into the cavity reached down to the posterior lacuna of the vagina. A counteropening was made here on the end of a strong forceps, and a large drainage-tube introduced through the vagina into the sac and brought out of the abdominal opening. There was slight hemorrhage from the walls of the sac, which were covered with a soft layer of nodulated granulating tissue. This was partially scraped out and partially disinfected by a 10 per cent. solution of chlorid of zinc. The edges of the abdominal opening of the sac were united to the lower end of the abdominal wound with a double row of sutures, the deeper one including only the two peritoneal layers and the superficial one uniting the sac with the skin. The upper part of the abdominal wound was united in the usual way down to the sac. No drainage-tube was inserted into the abdominal cavity, as no adhesion had been either detached or ligated. A large antiseptic dressing was applied over the abdomen, iodoform gauze having been packed around the drainage-tubes, both above the symphysis and in the vagina. The operation occupied an hour and a half.

The patient vomited twice during the afternoon. The pain in the abdomen was controlled by hypodermic injections of morphin. She complains of thirst, and is warm and perspiring. A small quantity of dark, greenish colored urine was withdrawn by catheter. Pulse, 140; temperature, 100.6° F.

September 17th, 1 A. M.: Pulse, 132; temperature, 101.5° F. She has been delirious for two hours, and throws herself from side to side of the bed. 6 A. M.: Pulse, 132, weak; temperature, 103.2° F. 8 A. M.: Pulse, 126; temperature, 104° F. She complains of pain, and there is tenderness in the right side of the abdomen, in the right lower part of which some resistance can be felt, which was not noticeable yesterday. On removal of the dressings there is no discharge from the drainage-tubes. Thinking that the considerable rise in temperature was due to accumulation of fluid in the peritoneal cavity on the right side of the sac, I reopened the wound under ether narcosis. Three to 4 ounces of bloody serum were found in the right iliac fossa, and antiseptic sponges introduced to clean the cavity, from which a number of shreds of fibrinous exudate were removed. A drainage-tube 6 inches long was inserted and the wound reunited. 3 P. M.: Pulse, 112; temperature, 101° F. She has slept for two hours, but is now delirious and restless again. 7 P. M.: Was quiet and talked rationally for a couple of hours in the afternoon, but soon lapsed again into delirium, and is now wild and excited, so that it is necessary to apply a strait-jacket.

September 18th, 7 A. M.: Pulse, 118; temperature, 100° F. She slept quietly most of the night; talks rationally, is bright, complains of no pain, and says she feels hungry. 11 A. M.: Pulse, 130; temperature, 101° F. About an hour ago she became delirious and wild again, but was quieted by a hypodermic injection of morphin and atropin. The wound was dressed, and very little discharge from either drainage-tube was found. All traces of iodoform were removed from the abdomen and vagina, the sac of the abscess washed out with saturated solution of boric acid, and the wound dressed with borated cotton. 6.30 P. M.: Pulse, 122, very feeble and irregular; temperature, 101° F. There is subsultus tendinum. The lower jaw constantly moves, and the lips tremble. At times she mutters a few unintelligible words. There has been no vomiting, and she takes considerable quantities of milk, champagne, and whisky.

September 19th, 9 A. M.: Pulse, 112; temperature, 99.8° F. She slept a little during the night, and on awaking was quiet and perfectly rational. Says she is hungry. Has taken hot milk, brandy, and iced champagne, and retains all she takes. 12 NOON: Pulse, 114; temperature, 100° F. Wound was dressed. There was a slight discharge of fetid pus from the abscess cavity, and a few drops of purulent fluid from the abdominal cavity. The drainage-tube into the latter was shortened 2½ inches. 7 P. M.: Pulse, 126; temperature, 100° F. Patient has been quiet all day and rational. The quantity of urine, which has been drawn by catheter three times a day, is only 3 to 4 ounces, amber colored, and contains nearly 50 per cent. of albumin and a number of granulated casts.

September 20th, 7 A. M.: Pulse, 112; temperature, 100° F. She slept fairly well, and takes soup and milk in considerable quantities.

September 21st, 7 A. M.: She was somewhat delirious during the night, but got quiet toward morning. 3 P. M.: Pulse, 96; temperature in rectum, 99° F. Very little discharge in the dressings. She is rational and complains of no pain. The abdomen is soft and natural. No tenderness anywhere.

September 22d, 12.30 P. M.: Pulse, 104; temperature in rectum, 99.5° F. She was slightly delirious last night, but slept most of the time; takes considerable nourishment. The abdominal drainage-tube was shortened 2 inches.

September 23d, A. M.: Pulse, 110; temperature in rectum, 100° F. 6 P. M.: Pulse, 150, weak and small; temperature in rectum, 101.4° F. She has been slightly delirious all the afternoon. Does not answer questions rationally. Her hands are cold, and she looks collapsed. 8 P. M.: Pulse, 156; temperature in rectum, 101° F. She is troubled with singultus; is rational now, and says she is very weak and feels sick.

September 24th, 2 A. M.: Pulse, 130; temperature in axilla, 99.3° F. Late last evening she became warmer, and slept several hours during the night. Had some diarrhea, and most of the liquid feces came out through the vagina and the drainage-tube. 6 A. M.: Pulse, 136, weak; temperature in rectum, 101° F. She is restless. Very little discharge in the dressings. Takes nourishment as usual, but somewhat less in quantity. 5.30 P. M.: Pulse, 130, weak; temperature in rectum, 101° F. Patient is in semi-unconscious condition, restless, and continually troubled with singultus. No vomiting; no evidence of peritonitis. She takes nourishment, but swallows slowly. She is warm all over the body. There is some hyperesthesia, as the hypodermic injections cause her to complain more than usual.

September 25th, 7 A. M.: Pulse, 140, almost imperceptible at the wrist; temperature in rectum, 106° F. She has been in the same semicomatose condition all the night. Has singultus all the time. It is difficult for her to swallow, and the extremities begin to be cold. At 11 A. M. the patient died.

Autopsy twenty-four hours after death, in the presence of Drs. Auten, Thiele, and others of the internes. The body was not emaciated. No edema. Rigor mortis. No pus in the dressings. Heart and lungs normal. No fluid in the abdominal cavity.

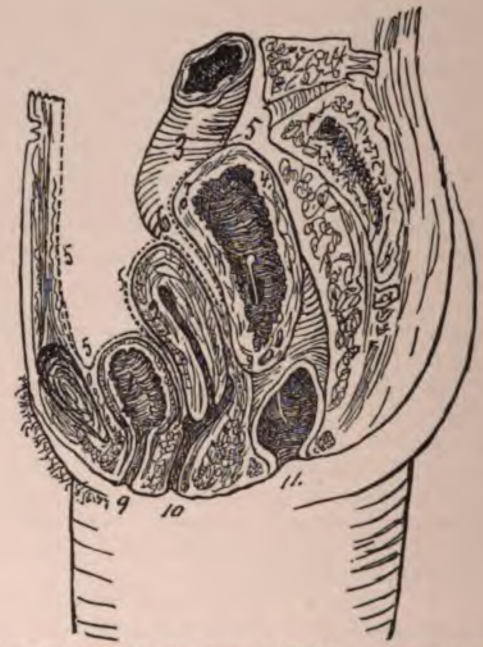

Fig. 39.—Sagittal section through pelvic organs: 1, Bladder; 2, uterus; 3, rectum; 4, abscess, with opening into rectum, where probe is passed through; 5, broken line showing the peritoneum covering the pelvic organs; 6, narrow space covered with peritoneum between posterior wall of uterus and anterior wall of abscess; 7, transverse section of left Fallopian tube in abscess wall; 8, large uterine vessels in inferior posterior part of abscess wall; 9, urethra; 10, vagina; 11, anus.

Peritoneum everywhere glistening and healthy. The peritoneal drainage-tube is only 1½ inches long, and the narrow canal in which it lies contains a few drops of pus and is firmly adherent all around, and separated from the peritoneal cavity at large. Liver of normal shape and size, somewhat pale, but otherwise normal. Spleen enlarged to twice its normal size, and shows on its cut surface the features of a typical sago spleen—that is, amyloid degeneration of the Malpighian follicles. Reaction with iodin distinct. Kidneys of normal shape and size, capsule small, not more adherent than usual; the cortical substance somewhat pale in contrast with the dark-red pyramids; the boundary between the cortical substance and pyramids distinct. Solution of iodin poured over the cut surface shows amyloid reaction of a number of the glomeruli.

Microscopic Examination and Description of the Organs of the Pelvis Minor.—The microscopic examination of the kidneys shows the following: In the cortical substance, in almost half of the glomeruli, is found amyloid thickening of the afferent arteries and of the capillary arteries of the glomeruli. In some of them the wall of the glomerulus is thickened. There is also found a number of urinary tubules filled with solid, refracting, homogeneous amyloid casts, and in some places the transformation of the epithelial cells of the canals into amyloid matter can be distinctly recognized by the enlargement and homogeneous refracting appearance of the epithelial cells. In the pyramids no amyloid degeneration, either of the vessels or of the urinary tubules, is found.

The spleen presents the usual microscopic appearance of amyloid degeneration of the Malpighian corpuscles, and the walls of the arterioles leading into the latter.

The pelvic organs, removed as a whole, show the following: In the left broad ligament is an abscess, thick walled, 4 inches long, 3 inches broad, covered with a smooth layer of peritoneum. The top of the abscess is at the height of the fundus of the uterus, and the peritoneum from the latter stretches out continuously over the abscess. From this point the abscess extends along the posterior surface of the uterus downward and inward along the left side of the rectum. The wall of the abscess is ¼ inch thick, consisting of firm white fibrous tissue. Under the microscope this is found to consist of an inner layer of young connective tissue, densely infiltrated with small round-cells, leukocytes, especially near the rugged inner surface of the abscess cavity. This layer is about 1 mm. in thickness. Outside of this is a heavy layer of dense fibrous tissue containing a small amount of medium-sized vessels. This layer is about 4 mm. in thickness. Outside of this, nearest to the peritoneum, comes a layer about 1 mm. in thickness, in which longitudinal and transverse bundles of organic muscular fibers are predominant over the connective tissue surrounding them. Outside of this is a smooth covering of peritoneum.

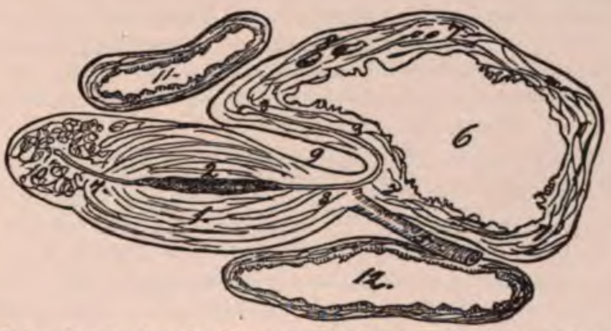

Fig. 40.—Horizontal section through pelvic organs at level of corporis or fundus uteri: 1, Fundus uteri; 2, cavum corporis; 3, left Fallopian tube; 4, right Fallopian tube; 5, ligamentum teres; 6, abscess cavity; 7, abscess wall; 8, uterine vessels in abscess wall; 9, narrow space covered with peritoneum between posterior wall of fundus uteri and anterior wall of abscess; 10, mass of brownish-red connective tissue surrounding right Fallopian tube—remainder of hematocele; 11, rectum; 12, bladder.

On the right side of the abscess wall, 3 inches from the top and 1 inch from the bottom, is an opening into the rectum large enough to permit the passage of a goose-quill, as shown in Fig. 39. The opening in the rectum is exactly 4 inches above the anus. The left round ligament passes along the anterior surface of the abscess, as shown in Fig. 40, which is situated between this and the Fallopian tube. The left Fallopian tube is twisted around and pressed against the posterior surface of the uterus, and runs down along the latter in the abscess wall. A fine probe introduced in the peripheral end of the Fallopian tube comes out into the abscess cavity. Along the right border of the uterus is a firm longitudinal tumor (10, Fig. 40), 2 inches long, ¾ inch broad, firmly connected with the side of the body of the uterus, and covered with peritoneum continuous from the latter. A section through this tumor shows uniform, reddish-brown tissue, in which the canal of the right Fallopian tube is embedded. This canal widens downward toward the lower end of the mass into an irregular, ragged cavity, ¾ inch long, ¼ inch broad, from the bottom of which the probe passes down into the rectum through the same opening as the abscess in the left broad ligament. Another opening passes directly from the small cavity into the large abscess cavity. In the bottom of the large abscess cavity is a large incision opening for the drainage-tube into the culdesac of the vagina.

Between the posterior surface of the corpus of the uterus and the anterior surface of the abscess wall there is a space or cavity, ¾ inch broad, 1¼ inches deep, and 1 or 2 lines in anteroposterior diameter. This space is covered all over with peritoneum, and forms a recess or culdesac, extending deep down between the uterus and the abscess (6, Fig. 39; 9, Fig. 40), closed at the bottom, and communicating upward with the general peritoneal cavity. It will be seen from Fig. 39 that if the operator undertakes to dissect up from the posterior lacuna along the posterior surface of the neck of the uterus, such recesses might easily be penetrated, and the peritoneal cavity in this way opened.

The true situation of the abscess is readily seen in Fig. 40. It lies in the broad ligament between the round ligament and the Fallopian tube, separating these to such an extent that the Fallopian tube is bent backward and to the right, so that it runs parallel with the posterior surface of the uterus. It will be seen, further, that the whole superficial third of the abscess is covered with peritoneum, which extends down from the abscess into the recesses between the latter and the uterus, and, further on, covers the uterus and bladder in the usual way, forming these recesses before extending over on the posterior surface of the anterior wall of the abdomen. It will be seen from this that there is no possibility of reaching the abscess from above without penetrating the peritoneal cavity.

It might be questionable whether it is justifiable to operate in a case where albuminuria and the ominous edema of the legs have already developed. It is still a matter of doubt whether amyloid degeneration, while yet in its initial stages, may not be made to disappear by removing the cause. The edema around the ankles might, in cases of this kind, be due to pressure on the iliac vessels by the tumor. This would deprive it of a portion of its ominous significance.

Not to operate is to leave the patient to her fate, and I must confess that I am not sure that I should absolutely refuse to operate in an exactly similar case in future. That this patient died from uremia there can be scarcely any doubt, as she had no peritonitis, and as her temperature for the five or six days immediately preceding death and during the time of the wildest delirium, alternating with the semicomatose condition, was almost normal. This, taken together with the condition of the internal organs, as shown by the autopsy, precludes any suspicion of septicemia. I have every reason to believe that if this patient had been operated upon in time, that is, about a year earlier, a cure might have been effected.

That an early operation enables us to effect a comparatively speedy recovery is well illustrated by the following case:

CASE III.—*Chronic peri-uterine abscess in the left broad ligament. Perforation into rectum and intermittent discharge of three months' standing. No fever. Laparotomy with evacuation of 20 ounces of fetid pus. Sac united to abdominal wound. Out of bed in five weeks. A week later abscess cavity closed down to narrow fistulous opening, with minimum amount of discharge. Two weeks later the fistula closed permanently.*

Mrs. Inga Jenson, twenty-nine years of age, came to me from Racine, Wis., November

26, 1884. Family history good. Parents both living and healthy. Her menses commenced in her fifteenth year, and have always been regular. She was married at nineteen, and a year later her first child was born, after protracted labor. For six months succeeding parturition she was confined to her bed, first suffering from fever and local peritonitis or severe pelvic cellulitis. During this time, also, an abscess was formed in the right breast, which was opened and suppurated for some time. After this she felt as strong as before her illness. Two years and a half after the birth of the first child she was delivered of a second child at full term. The labor was easy. She nursed the child eleven months from the sound breast, and was well for two years subsequently. She then began to suffer from pain in the left inguinal region, of varying intensity. Early in June, 1884, she did a hard day's washing, and on the following day house-cleaning, after which she was much prostrated, and said she felt too tired to eat or sleep. For the next nine weeks she was confined to bed on account of severe pain in the left inguinal region, accompanied by some fever, which, however, subsided after a week or two. Last September she first noticed a discharge of pus from the rectum. At first the daily discharge was about half a teacupful, and occurred independently of the fecal evacuations. The discharge for some time occurred irregularly—once or twice in forty-eight hours, later on, two or three times a week, and, finally, only once a week. In these two months she has had no fever, but has often suffered from attacks of pain, and felt weak and tired. She has had a fairly good appetite throughout, has slept well, and had no night-sweats.

On examination I find her pale, not emaciated; heart and lungs normal; no edema of the lower extremities; urine normal; pulse, 78; temperature, 99.8° F. In the lower part of the abdomen is a tumor commencing above the symphysis pubis, and extending up to 1 inch below the umbilicus, situated in the median line, 4 inches broad, and extending a little farther on the left than on the right side. Vaginal examination shows the uterus immovable, somewhat dislodged to the right and toward the symphysis pubis. In the posterior lacuna and in the left broad ligament is felt a hard swelling in which no distinct fluctuation can be detected. Bimanual exploration shows the uterus to be united with the tumor into one immovable mass. Digital exploration through the rectum enables me to feel the tumor, but no place of perforation.

Diagnosis.—Peri-uterine abscess in left broad ligament, communicating with the rectum.

On December 3d, assisted by Drs. Jacobson, Guerin, Randall, Murphy, Verity, Auten, and Thiele, I performed laparotomy. An incision was made from 2 inches below the umbilicus downward 5 inches in the median line, through the abdominal walls. The omentum that lay loose on the anterior surface of the tumor was pushed aside and the tumor exposed, which was covered all over with peritoneum of the color of the normal uterus. To the left it was adherent to the sigmoid flexure, and on its right side was a cyst, 3 inches long and 1½ inches in diameter, with thin, transparent walls. A hypodermic needle was introduced into the tumor and a little pus withdrawn. The surrounding peritoneal cavity was packed with antiseptic sponges, an aspirator needle introduced, and about 20 ounces of very fetid, greenish-yellow pus withdrawn. A longitudinal opening 1½ inches long was now made through the wall of the abscess by means of the thermo-cautery. The edges of the sac were secured with forceps and sponges introduced. Slight hemorrhage ensued from the nodulated granulating surface of the inside of the sac, but ceased after the application of a 10 per cent. solution of chlorid of zinc. The cyst on the right side of the sac was emptied. It contained about 2 ounces of clear serous fluid. The opening into the sac was now united with the abdominal wound by one deep and one superficial row of silk sutures, and two large drainage-tubes, one perforated, the other not, were inserted to a depth of about 8 inches. The remainder of the abdominal wound was united with sutures. A heavy antiseptic dressing was applied, and the patient brought to bed. The operation lasted about two and a half hours.

December 4th, 6 P. M.: Pulse, 102; temperature, 100.5° F. She has had some pain, which was controlled by morphin. Has been rather restless, and has vomited twice; looks well; has taken some champagne.

December 5th, 8 A. M.: Pulse, 96; temperature, 100° F. Has slept for two hours at a time. There is considerable discharge of bloody fluid in the dressings. Cavity was washed out with a saturated solution of boric acid. 9 P. M.: Pulse, 100; temperature, 99.5° F. She complains of pain in the right iliac region, and has vomited once.

December 6th, 6 A. M.: Pulse, 100; temperature, 99° F. The pain continued the first part of the night, but the patient was relieved toward morning. 12 NOON: Pulse, 108; temperature, 100.5° F. There is very little bloody discharge in the dressings; some tympanites of the abdomen, but less pain and tenderness in right iliac region. 6 P. M.: Pulse, 116; temperature, 102° F. She has had an ounce of milk twice in the last hour.

December 7th, 9.30 A. M.: Pulse, 108; temperature, 102° F. Does not complain of any pain in the abdomen, but of pain in the back. Urine taken with a catheter is slightly alkaline, and contains triple phosphate crystals, urates, moving vibrios, and pus. 3 P. M.: Pulse, 114; temperature, 102.5° F. 5 P. M.: Pulse, 120; temperature, 103.2° F. On account of this rise in temperature I resolved to make ready to reopen the abdominal wound, but when I returned with the necessary instruments two hours later the pulse had fallen to 100, and the temperature to 101° F., and she had no pain. I therefore resolved to wait.

December 8th, 8 A. M.: Pulse, 104; temperature, 101° F. She slept well the last part of the night, has no pain, and feels well this morning. The bladder is washed out three times a day with saturated solution of boric acid. 6 P. M.: Pulse, 104; temperature, 100.2° F.

December 9th, A. M.: Pulse, 96; temperature, 100.8° F. P. M.: Pulse, 96; temperature 100° F.

December 10th, A. M.: Pulse, 98; temperature, 99° F. P. M.: Pulse, 100; temperature, 99° F.

December 11th, A. M.: Pulse, 104; temperature, 99.7° F. She has slept well all night and takes considerable nourishment. A small abscess in the lower end of the abdominal wound has opened through one of the sutures.

December 12th, A. M.: Pulse, 98; temperature, 99.5° F. P. M.: Pulse, 100; temperature, 99.5° F. From this time on pulse and temperature remained normal.

December 13th: All the sutures were removed.

December 15th: The discharge is becoming less. The tubes are beginning to be pressed out by the retraction of the abscess cavity, and are shortened 2 inches.

December 16th: Had a slight spontaneous discharge from the bowels.

December 19th: A considerable movement of the bowels this morning caused her some pain. The depth of the cavity is now only 4 inches.

December 26th: The patient sits up in bed. When the dressing was removed, it was found that the drainage-tubes had been pressed out, and they were replaced with difficulty.

January 8, 1885: The patient is able to get out of bed. There is very little discharge. The tubes were pressed out and replaced by a small tube which is passed in about 3 inches.

January 14th: The patient leaves the hospital and returns home. On examination there is now found a small fistulous opening in the lower end of the abdominal wound, through which a probe can be passed in about 3 inches downward, backward, and to the left of the uterus. The amount of the discharge from the sinus is about 1 dram in two days. Vaginal exploration shows the uterus a little to the left and movable. No exudate or hardness can be felt on any of the sides. High up in the posterior lacuna above the neck I can just reach with the tip of my finger a movable, resistant body, which feels like a string or band extending from the posterior side of the uterus downward and backward toward the rectum.

She has had no diarrhea since the operation, has a good appetite, and can walk about the room all day without any pain in the pelvis whatever.

February 1st: The fistulous opening is closed.

The course of the after-treatment in this case was not so smooth as in the first case, on account of a small abscess in the lower end of the abdominal wound and an attack of cystitis. To which of the two the rise in temperature on the fourth day after the operation was due I am not able to state; but this rise in temperature, taken together with the pain in the right side of the abdomen, made me, at the time, regret that I had not inserted a drainage-tube in the abdominal cavity to the right of the abscess, in the region of the cyst. I came very near reopening the abdominal wound, fearing an accumulation of septic fluid in the right iliac fossa. The speedy retraction of the large abscess cavity and cessation of the discharge only proved that Lawson Tait* is right in asserting that recovery subsequent to free opening of an abscess of this kind by laparotomy is much quicker and more effective than when the abscess has been opened through the vagina.

In the following remarks I desire to call attention, first, to the operation of laparotomy from a technical point of view; second, to its position as compared with other operations; and, finally, to a few points in diagnosis.

1. *The Operation of Laparotomy.*—The abdominal incision, 3 to 5 inches long, in the median line, will always reach the upper convexity of the abscess, and has nothing worthy of mention, except that the abscess may be reached without penetrating the peritoneal cavity in case the peritoneum has been pushed upward by an ante-uterine abscess. In cases of this kind it is necessary to be careful to avoid cutting into the bladder, which may have been drawn upward by the abscess wall. It is consequently necessary, when the abdominal incision is made, to have an assistant mark out the site of the bladder by a sound introduced into it. If the abscess is thus extraperitoneal, the operation is greatly simplified, and is to be considered the same as the opening of any other abscess.

In the majority of cases, however, when the abscess is lateral or posterior to the uterus, it can be reached only by opening the peritoneal cavity,—that is, by laparotomy,—for which preparation has always to be made, since it is impossible to make a clear diagnosis beforehand as far as this point is concerned.

When the abdominal cavity has been opened, we usually come right down on the sac of the abscess. If covered by omentum or intestines, these have to be pushed aside, and all possible adhesions ligated or detached. The upper surface of the sac, together with the uterus and appendices, will generally form a convex, red, smooth, more or less regular tumor, to the sides of which, outward toward the brim of the pelvis minor, loops of intestine or omentum generally adhere; but as we do not wish to extirpate the sac, we need not disturb these parts, if only a surface of 2 inches in diameter is clear—that is, space to admit of a sufficient opening being made into the sac, and of a sufficient margin around the opening for a double row of sutures to unite the edges with the anterior wall of the abdomen.

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* *Op. cit.*

When the upper surface of the sac is thus clear or has been cleared, the next step is to find some way into the sac, with due regard to the prevention of the escape of pus into the abdominal cavity. To this end I always pack two or three large disinfected sponges around the sides of the cleared space, at the same time preventing any loops of intestine from slipping out through the abdominal incision.

We cannot expect always to find a soft or fluctuating point on the surface of the tumor, especially when the abscess communicates with the rectum or bladder, or, more rarely, with some remoter part of the intestinal canal. The sac cannot usually be distinguished, by touch or view, from the fundus of the uterus. The round tumor is uniformly elastic to the touch, feeling like a soft fibroid or a soft, enlarged uterus. An exploratory puncture has consequently to be made with the needle of a hypodermic syringe at the point and in the direction where, from the previous examination, we expect the abscess to be, or where the tumor feels less resistant than in other places. It is often necessary to introduce the needle several times, and in different places, before any pus can be withdrawn. In cases where the abscess has been evacuated into the rectum or elsewhere, and the cavity is consequently empty, the needle must be moved in various directions until a place is found in which it can be moved freely, indicating the presence of a cavity.

If pus is withdrawn, thus proving that the abscess cavity has been reached, it is advisable to effect as perfect an evacuation of the contained pus as possible. I consequently have the aspirator ready, and introduce the aspirator needle along the needle of the hypodermic syringe, which is left in the cavity as a guide. If this precaution is not taken, it may sometimes be most difficult to find the abscess cavity a second time. The pus, which is usually fetid, is now aspirated, and the aspirator needle left in the cavity as a guide for the knife in the incision into the sac. I advise that this incision be made by the thermocautery; the small, knife-shaped burner of Paquelin answers the purpose very well. I use this to avoid unnecessary hemorrhage, because it saves time and prevents the blood, mixed with pus, from overflowing the peritoneal surface of the sac, in the wall of which the large uterine vessels may run, and we can never know where. It is well to have a small sponge ready to thrust into the sac as soon as the incision is made, because some pus is likely to flow out as soon as the sac is opened.

I then seize the edges of the incision with large, strong artery forceps—the large forceps of Billroth answer the purpose very well. By means of the forceps the opening into the sac is drawn forward, and the hemorrhage from the surface, often nodulated and bleeding easily, checked by the introduction successively of a number of small sponges held by artery forceps. To aid in checking the hemorrhage, and at the same time disinfect the inner surface of the sac, these sponges may be saturated with a 10 to 20 per cent. solution of chlorid of zinc, or, if necessary, the inside of the cavity may be scraped out with the sharp spoon or curet (Byford*).

If a counteropening from the sac to the vagina is desired, a strong curved forceps is pushed down to the bottom of the sac until it can be felt through one of the culdesacs of the vagina, through which an incision is then made by one of the assistants on the end of the forceps. The forceps is then pushed through this opening, and opened so as to dilate the latter. A heavy drainage-tube is now firmly grasped by the jaws of the forceps and drawn up from the vagina through the sac and out of the abdominal incision.

The next step is then, after carefully cleaning the peritoneal surface of the sac, to unite the latter to the part of the abdominal wound nearest to it by a double row of sutures. I use silk for all the sutures. The deeper row, about ¼ inch from the edge of the opening into the sac, and not penetrating the whole thickness of the wall of the latter, unites the peritoneum of the sac with the peritoneum of the anterior wall of the abdomen. These sutures must be sufficiently near to each other (less than ¼ inch apart) hermetically to close up the peritoneal cavity. The outer row of sutures passes through the entire thickness of the abscess wall, along the incision into the sac, and through the whole thickness of the abdominal wound, thus uniting the edge of the skin with the edge of the inner wall of the abscess cavity. The rest of the abdominal wound is then united in the usual way after the removal of the large sponges and the necessary toilet of the abdominal cavity.

The question arises here whether or not it is advisable to insert a drainage-tube into the abdominal cavity. This depends, of course, as in all other laparotomies, entirely upon the amount of detached adhesions. But in laparotomy for abscesses it is more desirable not to have a drainage-tube in the abdominal cavity, because of the danger of a secondary infection from the fetid abscess cavity through the abdominal drainage-tube, as it is practically almost impossible to effect a perfect seclusion between the abdominal tube and the tube leading into the abscess. Such a necessity may, however, arise, and then the best course possible under the circumstances is to be pursued.

Heavy antiseptic dressings should be applied over the abdomen, and also an intravaginal and an extravaginal dressing sufficient to cover the drainage-tube in the vagina. I consider iodoform in such cases especially valuable when communication with the rectum makes it possible that feces will come in contact with the abdominal wound. The dressing should be changed at least once a day, and the sac washed out with an antiseptic solution, for which I prefer saturated solution of boric acid, as there is then no fear of poisoning. In other respects there is nothing in the after-treatment worthy of especial mention. The drainage-tubes should be shortened or removed, as the retraction of the sac and the diminution in the amount of pus discharged demand. The sutures in the abdominal wound should be removed as usual; also the superficial row, uniting the sac with the skin, the deep row of sutures around the sac being left in permanently.

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* American Gynecological Association, Philadelphia, September, 1883; Medical Record, 1883, vol. xxiv, p. 357.

It is natural to expect that some infection may take place along the stitches at the lower end of the abdominal wound, between the sac and the symphysis, and that consequently an abscess may form here in the wall. This complication is, however, not likely to prove very serious, as the pus has already a ready-made exit along the stitches.

In close connection with the operation of laparotomy for peri-uterine abscess the question naturally arises: Would it not be safer, in such cases, as it unquestionably is in the opening of abscesses of the liver, to operate *in templis*, that is, to effect union of the surface of the sac with the anterior abdominal wall before the abscess is opened (Volkmann)? The safety of performing the whole operation at one sitting will depend, to a certain extent, upon the skill of the operator; but Lawson Tait's record of 30 operations, each at one sitting, without a single accident, may be considered almost a definite answer to the question. There is, moreover, a very tangible difference between an abscess in this locality and an abscess in the liver, in the following respects:

The liver participates in the respiratory movements: the peri-uterine abscess does not. The wall of an abscess of the liver is friable, and furnishes a very insecure substratum for the application of sutures, while the walls of a peri-uterine abscess are thick and solid.

Regarding effective drainage of a peri-uterine abscess, the question comes in of the advisability of making a counteropening through the vagina. Lawson Tait's experience, as well as my own, seems to indicate that the counteropening through the vagina is not necessary, and I think I shall not resort to it in future operations, at least not at the time of operation. If, in the course of the after-treatment, rise in temperature and the accumulation of pus in the lower part of the sac should demand it, a counteropening in the vagina can be made.

2. Laparotomy as Compared with Other Operations.—When a peri-uterine abscess points somewhere in the vagina around the lower part of the uterus, no surgeon would, of course, think of doing anything but opening the abscess, inserting a drainage-tube, and, by washing out, endeavoring to effect the closure of the cavity. But in some cases the opening into the vagina is just as ineffective as a spontaneous opening into the rectum. In obstinate cases of this kind laparotomy will have to be performed at a later period.

There is, however, no doubt that secondary invasion of septic poison, when the abscess is opened from the vagina, is much more difficult to prevent than invasion into the abscess from the abdominal opening. It is only in this way that we can account for the difference in the course of the after-treatment of peri-uterine abscesses opened through the vagina and through the abdominal cavity—a difference that Lawson Tait rightly calls attention to as being decidedly in favor of the abdominal operation. Here the abscess closes more quickly, and the course of the after-treatment is much less febrile than in the vaginal operation.

Sometimes a peri-uterine abscess will point into the rectum, sufficiently low down to permit of an opening here. It does not seem probable that the access from the rectum will be very promising, as effective drainage is next to impossible, but the cases of cure by spontaneous opening into the rectum evidently make an operation here permissible, and perhaps advisable, but only as a trial. If the abscess does not retract within a reasonable time, other measures must be resorted to.

It is needless to state that if a parametritic abscess points anywhere along the iliac fossa, it should be opened and drained from this point; but this does not belong to my subject of today, as I desire to call attention only to strictly circumuterine abscesses, which can be reached only from the vagina or from the suprapubic region.

When a circumuterine abscess does not point downward, and, in fact, does not point anywhere, it is then the surgeon's task to find the safest way into the abscess through a smaller or larger amount of surrounding tissues. We shall first consider the vaginal operation:

When so eminent an authority as Schröder, of Berlin, advocates this method of reaching a high peri-uterine abscess, there must be cases in which this operation is advisable. From a general point of view an extraperitoneal outlet of the abscess through the vagina would seem to be safer than laparotomy, upon the same grounds as a vaginal hysterectomy is safer than Freund's abdominal hysterectomy, and Schröder's successful operations, already mentioned, vouches for the method.

At the same time, I firmly agree with Lawson Tait that there are some grave objections to the vaginal operation. In the first place, a high-seated peri-uterine abscess is difficult to reach. It is difficult to work with safety 2 or 3 inches above the introitus of the vagina, in tissues that are immovable, and where the parts cannot be drawn down toward the operator. These difficulties are, of course, of less importance in the master hands of an operator like Schröder, but increase in significance for less experienced surgeons.

But the operation through the vagina is more or less an operation in the dark. As shown in Fig. 39, we may be dissecting up along the posterior surface of the neck of the uterus, and may open into recesses of the peritoneal cavity between the abscess and the uterus. Further, it might be easy in this place to open into the rectum.

Another danger, especially in abscesses between the two layers of the lateral ligament, might easily arise from the rupture of the large uterine vessels running in the wall of the sac, as shown in the illustrations. It would be exceedingly difficult, and I should say next to impossible, under such circumstances, to secure and ligate these vessels, the point of ligation being so high up, the working space so small, and the tissues so immovable.

All these objections and dangers we do not encounter in laparotomy. We can see distinctly, and recognize with our eyes, every particle of tissue we have to divide; the large uterine vessels, if divided, can easily be taken up and ligated. There is no risk of having any communication between the abscess and the peritoneal cavity, which we cannot either close up or drain.

If the laparotomy lasts longer and gives more technical work to the surgeon, it seems to me that these objections are fully balanced by the advantage of not being obliged to operate in the dark, of not having to battle with enemies that we cannot see, and consequently cannot guard against.

But these are not the only advantages of laparotomy as compared with the vaginal operation. The free access to the whole interior of the abscess cavity has also to be taken into account. By laparotomy the abscess is laid open to about the same extent as a tubercular peri-articular abscess. We can examine the whole interior of such a cavity, and scrape off, or remove by other means, whatever objectionable material we may find,—cheesy matter, tuberculous tissue, fungoid granulations,—since we can see clearly every place where the instrument is applied, without any danger of going through the abscess wall into any surrounding cavity or organ.

It is more than possible that this free access to the abscess wall has something to do with the speedy recovery subsequent to laparotomy, as compared with the vaginal operation.*

But, of course, there will always be connected with laparotomy the inherited dread of opening that ominous peritoneal cavity. Modern surgery, however, is making steady progress in diminishing these dangers. Thus the dread, as well as the safety of the patient, will, to a great extent, rest in, or depend upon, the care and skill of the operator.

3. Points in Diagnosis.—It is, of course, always important to know, in a given case, if a circumuterine exudate contains pus, or if it is, as it may be in many cases for a long time, or may always remain throughout, a solid mass. Even a large abscess will often seem to the touch just as firm or tense as a fibroid or any other solid tumor.

As for the other differential diagnostic symptoms, tenderness and local heat are, of course, perfectly valueless. Bandl is hardly correct when he states† that the diagnosis of suppuration and formation of abscess in the pelvis is generally not difficult, because, as he says, we may expect pus when the evening fever increases and rigors and night-sweats appear. There are certainly cases in which even a large abscess containing more than a pint of pus may be present without fever, rigors, or night-sweats. I have twice seen such a case.

The question now arises how to make sure of the presence of pus in peri-uterine exudate that lasts so long, brings the patient down, and resists treatment so persistently that we have reason to suspect its presence. The first step, of course, to this end is exploratory puncture through the vagina. When this is made by a fine aspirator needle, I believe it to be comparatively safe. Of course, the finer the needle, the safer will the operation be; but, at the same time, it may be that the pus is so thick or slimy that it will not pass out into the syringe. A larger needle or trocar, which, of course, may have to be introduced in different directions and in different places, is not entirely harmless. Emmet says: "I cannot regard the introduction of the trocar into the inflamed tissues of the pelvis as a procedure free from danger under all circumstances."

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* Lawson Tait: *Op. cit.*

† Die Krankheiten der Tuben und die Extra-Uterin Schwangerschaft.

If, then, as is almost always the case, the abscess can be felt as a distinct tumor between the symphysis and umbilicus, the question of an exploratory puncture at this place might arise. I should never dare to do this, because the needle would pass through the abdominal cavity, in the majority of cases, and, when withdrawn from the abscess, would be followed by a drop of pus, sufficient to set up immediately a general acute peritonitis.

In consequence of this, and especially when the tumor presents above the symphysis pubis, I should feel inclined, even after unsuccessful vaginal exploration with capillary needles, to advise exploratory laparotomy. I would prefer to do this even if I had to encounter a solid tumor and close the abdomen again, rather than to expose the patient's life by too much exploratory puncture. I believe that exploratory laparotomy in such cases is less dangerous. I do not wish, however, to be understood as being an advocate of indiscriminate laparotomy for peri-uterine exudates, or for the mere satisfaction of a diagnosis; but I want this measure limited, of course, to obstinate chronic cases, where the very pertinacity of the exudate, even if no fever is present, indicates pus somewhere in the center of it, and makes the patient a confirmed invalid.

In cases like my three here published, where the abscess communicates with the rectum, there is, of course, no difficulty in diagnosis and no need of preliminary explorations. But every experienced gynecologist knows, postmortem reports in the literature show, and abscesses mistaken for fibroids prove, that a number of peri-uterine abscesses having no communication with any cavity outside of the abscess wall exist for a long time, with or without fever. It is for such cases, in my opinion, that exploratory laparotomy is indicated.

I had the opportunity, a few years ago, to make a postmortem examination in a case of a large circumuterine abscess (a patient of Dr. S. H. Stevenson, of this city) in which the patient had been an invalid for two years, and had traveled for her health two years in Europe and America. She finally died rather suddenly and unexpectedly, without having been confined to bed more than a day or two. A few hours previous to her collapse a copious, purulent, bloody discharge from the rectum indicated a rupture into this organ. The postmortem examination, although all important organs were examined, failed to reveal to me satisfactorily what the immediate cause of death was.

I further believe that it is dangerous to wait too long, in cases where we have every reason to suspect an abscess, before we operate, because the amyloid nephritis may, as shown in my second case, make us seriously regret the too late surgical interference.

In conclusion, I wish to pay a final compliment to Lawson Tait, the first advocate of free laparotomy in cases of this kind. It was the report of his first cases that gave me the courage to operate in my first case. The more attention I have had the opportunity to pay to this subject, the more I believe he is right; and I believe also that he has nplished a most important step forward in the successful treatment minous cases of chronic peri-uterine abscess.

TWO CASES OF EXTRA-UTERINE PREGNANCY (FROM EXAMINATION OF THE SPECIMENS)*

THE exact anatomic diagnosis or minute classification of an extra-uterine pregnancy is easy enough in the early stages of the disease, but it becomes more and more difficult in the latter half and toward the termination of the pregnancy.

In the earliest months of the pregnancy it is only by accident that a pathologic specimen is found. Here the exact diagnosis is easy enough. From the third to the sixth month specimens are secured by operation or after death, as the result of hemorrhage from rupture, and here the diagnosis is still comparatively easy.

In the latter half of pregnancy, from the sixth to the tenth month, the diagnosis, viz., exact location of the fecundated ovum, becomes often exceedingly difficult—next to impossible—on account of secondary changes and often partial destruction of Fallopian tubes and ovaries, and still more difficult if a fatal peritonitis has contributed to mask the normal anatomic features of the organs in question.

The two specimens sent to me for examination belong to the class of late and consequently difficult cases, and in one of them the specimen was very much decomposed. Nevertheless, I think that a close examination of the specimens permits of a comparatively exact classification of the two cases—at least, of one of them.

Before describing and demonstrating the specimens, permit me to recall to your memories the different forms of extra-uterine pregnancy:

Extra-uterine Pregnancy.—The ovum is arrested somewhere in its normal passage from the Graafian follicle down to the cavum uteri, or drops out of the passage, without or after rupture of the latter, into adjoining cavities or spaces.

1. Ovarian Pregnancy.—The ovum remains in the ovary. In *epi-ovarian pregnancy* the ovum develops on the ovary, having left the Graafian follicle.

2. Abdominal or Peritoneal Pregnancy.—The ovum falls down into the peritoneal cavity and does not enter the Fallopian tube at all.

3. Tubal Pregnancy.—(1) Tubo-abdominal or tubo-ovarian pregnancy. (2) Tubal pregnancy. (3) Tubo-uterine, interstitial, or mural pregnancy.

4. Extraperitoneal pregnancy in the broad ligament after rupture of the Fallopian tube.

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* Read before the Chicago Gynecological Society, February 20, 1885. Chic. Med. Jour. and Examiner, 1885, vol. xxx, p. 211.

5. *Pregnancy in one side of a uterus bicornis.*

6. *Secondary Abdominal or Peritoneal Pregnancy.*—Ovary, tube, or even uterus (*bicornis* or *normal*) is ruptured, and the fetus slips into the peritoneal cavity, but remains in connection with the primary sac.

I shall first describe and demonstrate Professor Byford's Case No. 2:

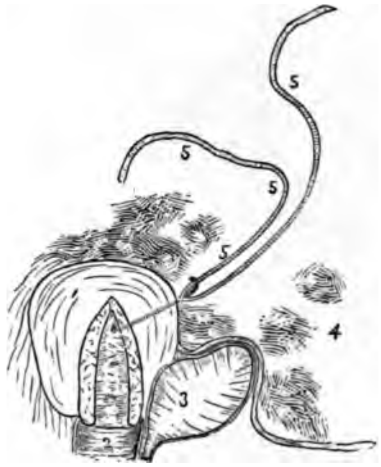

Fig. 41.—Case 2. Anterior view of sac and pelvic organs, left Fallopian tube laid open except in its uterine portion: 1, Uterus; 2, vagina; 3, bladder; 4, inside of fetal sac; 5, 5, 5, 5, Fallopian tube dilating and opening into the fetal sac.

Professor Byford's Case 2.—The uterus is large, 4½ inches long, 3 inches broad at the fundus; the cavity is also considerably enlarged. In the *left* side of uterus and vagina I find an incision opening, 3½ inches long, closed with silk sutures, leading from the uterus and vagina into the sac, or, as some members of the Society called it, the adventitious uterus. The sac can be seen only in fragments. Its wall is 1 to 2 lines thick, the outside partly covered with peritoneum, and partly adherent to the surrounding organs,

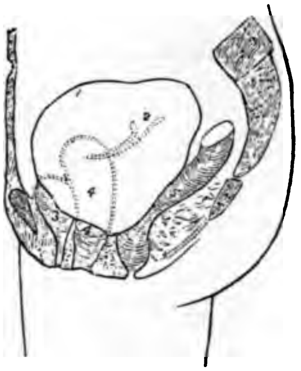

Fig. 42.—Case 2. Sac and pelvic organs seen from the left, to show situation of sac; 1, The sac; 2, dilated end of Fallopian tube opening into or continuous with the wall of the sac, which partially covers the following organs: 3, bladder; 4, 4, uterus; 5, rectum.

the placenta, and the upper two-thirds of the uterus removed. I shall not undertake, here, to describe the child, as it is irrelevant to the matter in question.

We find the uterine appendages of the right side, viz., broad ligament, round ligament, Fallopian tube, and ovary, normal (Fig. 43).

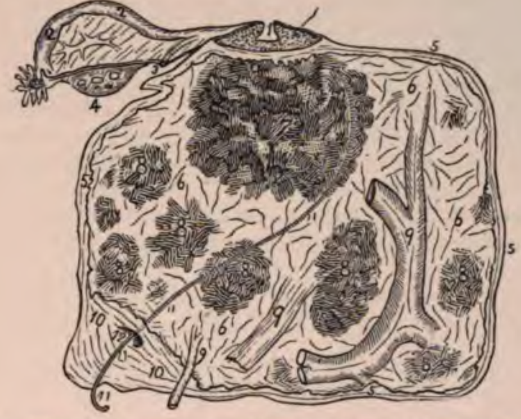

Fig. 44.—Case 1. Inside of the extra-uterine sac seen from below: 1, Uterus—transverse section of the neck, where the uterus was amputated, shows the open cavity of the neck; 2, 2, the right Fallopian tube; 3, right round ligament; 4, right ovary; 5, 5, 5, 5, the wall of the sac; 6, 6, 6, inside of the sac, with, 7, place of the placenta right behind the neck of the uterus; 8, 8, 8, 8, 8, 8, 8, accessory placenta places; 9, 9, 9, large vessels on and in the inside of the sac; 10, 10, place where the outer layer of the wall of the sac is separated from the inner layer because the wall has been cut obliquely here at the operation; 11, probe in the left Fallopian tube; 12, oval opening on the inside of the outer layer of the sac, viz., termination of the Fallopian tube or cross-cut of the Fallopian tube just before it (probably) opened into the cavity of the extra-uterine sac.

The uterus, amputated about the middle of the neck, is of normal size, viz., the cavity, 1¼ inches between the two uterine orifices of the Fallopian tubes. Farther down, 1 inch; still lower down, ½ inch, and in the neck, ¼ inch, broad. The average thickness of the uterine wall is ½ to ¾ inch. To the left and behind the uterus, and in uninterrupted

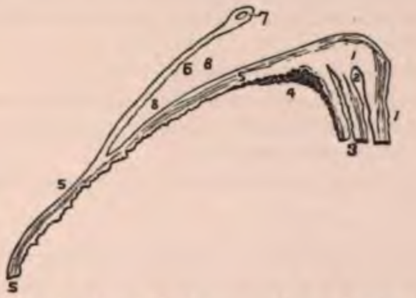

Fig. 45.—Case 1. Sagittal section through the uterus and the sac, showing the pocket on the posterior wall of the sac: 1, Uterus; 2, cavum uteri; 3, space (dissected) between posterior wall of the uterus and anterior wall of the sac; 4, place of the placenta on inside of sac behind the uterus; 5, wall of the sac; 6, posterior wall of the pocket, that is, the tubular or Fallopian fold of the left broad ligament; 7, left Fallopian tube, cross-cut showing its lumen; 8, pocket between 5 and 6.

connection with its surface, is the sac or adventitious uterus. Fig. 43 shows the uterus and sac seen from the anterior side. From the anterior surface of the sac, ¼ inch from the left corner of fundus, is the left round ligament; it is enlarged, ¼ inch in diameter. On the upper surface of the sac, behind and to the left of the fundus uteri, is a pocket covered with peritoneum, 2½ inches broad, 3 to 3½ inches deep (Fig. 45) (Case 1, Fig. 43, 10).

The upper free border of the pocket, or broad ligament, forms a somewhat thickened ridge, which runs in an arch, first to the left backward, then to the right, then divides into two branches—a lower one that runs downward and to the right, an upper one that runs forward to the left, pointing toward the left corner of the uterus. The ridge contains the left Fallopian tube (Figs. 43 and 45). The tube is 7 inches long—the same as the right tube. It runs to the left backward in an arch, and then bends to the right downward and backward; here it leaves the broad ligament, and the canal enters the wall of the sac. How it terminates—if on the inside of the posterior wall of the sac (Case 1, Fig. 44) or not—cannot be made out for certain, because the sac is cut off here, but as there are no fimbriæ, it does not open outside of the sac, and has undoubtedly opened into the fetal cavity.

The uterine portion of tube is of normal size, permitting the passage of only a very fine probe. The median portion of the tube is normal, perhaps slightly dilated, 3 to 5 lines wide.

The termination of the tube in the wall of the sac (Fig. 44, 12) is an oval opening, ¼ inch in diameter, the borders of which are perfectly smooth, no fimbriæ being visible anywhere.

Of the left ovary no trace can be found. The sac is clad on the outside with the peritoneum and is smooth.

The wall of the sac is from 1 to 8 mm. thick, white, and firm. The thickest part of the sac is right behind the fundus uteri, ¼ to ½ inch in thickness, and there the tissue, viz., fibers of the uterine tissue of the upper surface of the fundus, is continuous with the wall of the sac; however, on the posterior surface of neck and fundus the tissue of uterus is *not* continuous with the sac, but the latter is separated from the uterus by a short layer of connective tissue that permits of dissection and leaves the posterior surface of uterus and wall of sac with smooth surfaces. This is the place where the placenta was situated (Figs. 44, 7, and 45, 4). The inner surface of the sac has an uneven, ragged, or velvety appearance, most ragged over the site of the placenta, close to and behind the neck of the uterus. Outside of this region there are numerous islands of uneven, ragged, appearance, with more smooth spots between them. Several large vessels, ¼ inch in diameter (Fig. 45, 9), are found, partly free, partly adherent to the inside of the sac.

A microscopic examination of the wall of the sac shows the following:

(*a*) In the site of the placenta:

1. An inner layer of free cotyledons or fimbriæ.

2. A layer of maternal tissue, with cross-cuts of the cotyledons, embedded in cavities (whether lymph-spaces or blood-vessels I am unable to decide, but they look to me like venous blood-vessels) tightly surrounding them.

3. A heavy layer of connective-tissue bundles, interspersed with some organic muscle-bundles.

4. Peritoneum.

(*b*) A thick spot in the wall, near the peripheral opening of the Fallopian tube into the sac, which I examined to find ovarian tissue, presents exactly the same appearance as (*a*).

(*c*) A thin place in the sac, some distance from placenta and tube, gives—

1. An inner layer of areolar connective tissue without cotyledons.

2. A median heavy layer of connective-tissue bundles and bundles of organic muscle-fibers.

3. Peritoneum.

(*d*) A third place in the sac presents the same layers as (*a*).

Nowhere in the wall of the sac is any trace of ovarian tissue to be found.

In considering the anatomic diagnosis of this case I shall have to take into consideration mural, ovarian, tubo-ovarian, and tubo-abdominal pregnancy.

Can it be a mural or an interstitial pregnancy? The continuity of the sac, in the site of the placenta, with the upper surface of the fundus belongs to the signs of mural pregnancy.

The uterine portion of the Fallopian tube is of normal length and width, consequently the ovum cannot have lodged and developed here. However, a persisting "Gärtner's duct" might, perhaps,—it is doubtful,—form a lateral branch of the tube and run in the wall of the uterus. Baudelocque ("the nephew") claims that a mural pregnancy can take place when the fecundated ovum lodges in this blind branch. Kleinwächter, in his article, "Tubal Pregnancy," in Eulenburg's Encyclopedia, remarks that this statement of Baudelocque's has yet to be proved.

Aside from Gärtner's duct, there is another anatomic anomaly that might give rise to a mural pregnancy outside of the uterine portion of the Fallopian tube. Through the kindness of Professor Jaggard, of Chicago, my attention was called to this variety. The ovum may develop in a branch of a bifurcated Fallopian tube. Hennig* has an illustration showing a canal branching off from the Fallopian tube in the lateral wall of the uterus; the branch turns downward and inward in the uterine wall, and opens into the cavity of the uterus at the internal os. If the ovum is arrested in this branch, a mural pregnancy results. The sac will push the broad ligament and the appendices outward and upward, and we will expect, as in the ordinary mural pregnancy, to find Fallopian tube and ovary on the outside of the sac, and, further, we must expect that the round ligament should be dislodged outward some distance from the border of the uterus. Consequently, in our case, we cannot admit a bifurcated Fallopian tube as the seat of the pregnancy.

But supposing a mural pregnancy had taken place here, and consequently the uterine portion of the Fallopian tube could be found open outside of the sac: then we demand in this case certain conditions that cannot very well be dispensed with, and they are the following:

The abdominal end of the Fallopian tube, together with the ovary, must be found somewhere on the outer wall of the sac, and opening into the peritoneal cavity.

Supposing that the ovary, for some reason or other, was not found, and the abdominal end of the Fallopian tube was obliterated and buried in the wall of the sac, we might yet have had a mural pregnancy.

In this case, however, the Fallopian tube opens into the wall of the sac. If it has opened into the fetal cavity, it cannot be seen on this specimen. (However, it looks as if it had probably done so.)

The round ligament in mural pregnancy is expected to be pushed outward some distance from the side of the uterus. This might be different if the ovum could develop in the posterior wall of the uterus, but this possibility has never been proved. Gärtner's duct does not run in the posterior wall, but from the parovarium first in the broad ligament (in the same fold as the Fallopian tube), then in the muscular substance of the lateral border of the uterus, and down on the side of the vagina, where it terminates blindly.

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* Lusk, The Science and Art of Midwifery.

The sac can be dissected off from the posterior wall of the neck and fundus uteri, which looks as if the sac developed on the posterior surface and not in the posterior wall of the uterus.

Thus, although the positive proof against mural pregnancy, viz., the opening of the Fallopian tube into the cavity of the sac, is wanting, —the fault of the specimen,—then, as all signs of mural pregnancy are absent except the apparent continuity of sac-wall and uterus, I shall declare against mural pregnancy.

The microscopic examination of Dr. Byford's Case No. 1 (our second case) does not give any points as to the solution of the question of mural or tubo-ovarian pregnancy; the sac here consists just exactly of the same elements as I have found in a case of abscess of the broad ligament, in a wall as thick as the sac in its thickest parts. The presence of organic muscle-fiber in the sac, and the continuity or connection between the muscle-fiber of sac and uterine wall, is of only secondary diagnostic significance, for the following reason: the organic muscle-fiber or cell belongs to the *proletaires*, so to say, among the tissues; it is of the connective-tissue class, and can be formed and found everywhere where connective tissue is formed and found. In fibromyomata or myofibromata it is often impossible to determine what is a muscle-cell and what is a spindle-shaped connective-tissue cell. Consequently, continuity between muscle-fiber in sac and muscle-fiber of the uterus does not mean that the former originated in the latter.

The next question then is this: Is it an ovarian, tubo-ovarian, or tubo-abdominal pregnancy?

In an ovarian pregnancy we must have—(1) That the Fallopian tube does not participate in the formation of the sac (Kleinwächter); (2) ovarian tissue is found in the wall of the sac; (3) that there is a connection between the sac and the uterus through the ligamentum ovarii.

Of a tubo-ovarian pregnancy, we would require—(1) That the peritoneal end of the Fallopian tube participates in the formation of, that is, opens into, the sac; (2) the ovary may be intact, but it may also have been used up in the formation of the sac, and have disappeared either entirely or only remnants may be found in the wall of the sac.

(It is easy to see how difficult it may be to find microscopic remnants of ovarian tissue in the wall of a sac 100 times or more the size of a normal ovary.)

As near as we, in my opinion, are able to come to an exact diagnosis in this case, I should pronounce it a *tubo-ovarian pregnancy*.

The exact location of the spot where the fecundated ovum has commenced development it is, of course, impossible to prove to satisfaction. Still there is one interesting feature in this case which, in my opinion, throws some light on this point. This is the pocket—the blind pocket—on the upper wall of the sac behind the uterus (Fig. 43, 10, and 45, 8).

As before stated, the upper side of the posterior wall of the pocket, viz., the ligamentum latum, or the Fallopian fold of this ligament, forms a circular figure, commencing at the left border of the fundus and terminating at about the same point; from the connection between the middle and outer third a branch goes off downward and to the right. The Fallopian tube is contained in the first two-thirds of the ridge and in the branch. The final third of the ridge, that does not contain the tube, but runs back toward the left corner of the uterus, would, in my opinion, correspond with the ligamentum ovarii (Fig. 43, 7). The formation of the pocket, clad with the peritoneum, and having as upper border the above-described ridge, can, in my opinion, be explained if the ovum has been arrested and commenced development in the ligamentum "infundibulo-ovarianum" (Henle), between the fimbriæ that line the sulcus leading from the distal end of the ovary to the ostium abdominale of the tube. If the ovum is developed here, it can, with the vessels of the chorion—first, reach the abdominal ostium of the tube, and thus permit the tube to open into the sac; second, it can reach down on the lower or posterior surface of the ovary, and thus, during its growth, lift up the ovary at the same time as it destroys it, but in lifting it up preserve and enlarge the peritoneal fold or pocket that normally exists between the posterior surface of the peritoneal fold containing the Fallopian tube, and the anterior surface of the peritoneal fold containing the ovary and the ligamentum ovarii.

In case the fecundated ovum from the ruptured Graafian follicle had dropped down below the ovary and had been arrested or taken hold on the peritoneal surface of Douglas' fossa or on the posterior surface of ovary, if a development in such a way and place is possible, the pocket could be formed, of course, but we could not expect to have the Fallopian tube open into the wall of the extra-uterine sac. If the pocket in question is formed in cases where the ovum has been arrested in the peripheral end of the tube I do not know, as my access to original literature on this subject has been extremely limited, and the common text- and hand-books, of course, do not contain anything like a detailed description of any of the cases in question.

In the proceedings of the meeting of the Gynecological Society of December 19, 1884, Professor W. H. Byford is recorded to have said* as follows: In the first case (our Case No. 2, where operation was performed) he thought that the fecundated ovum had passed through the tube, but found some diverticulum in the uterine cavity, had passed into the uterine wall and developed in this region, pushing the wall before it. The muscular element of the sac was directly continuous with the uterine muscle. Further (pp. 64, 65): "It is not necessary for the production of mural pregnancy that the tubes be involved."

A diverticulum in the uterine wall that would permit the ovum to develop down between the muscle in the wall is, as far as I know, not known or proved, but such a condition might be accepted in a proved mural pregnancy in which the Fallopian tubes were not involved.

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* Chicago Medical Journal and Examiner, 1885, vol. xxx, p. 64.

A Gärtner's duct, as place of development for the ovum, is not proved either; but, accepted as a possibility, let us see what would be the consequence: The ovum would be arrested either in the extra- or the intra-uterine portion of the duct. (I do not know of any communication opening between Gärtner's duct and the Fallopian tube—does it exist?) If developed in the *extra-uterine portion* of the duct that runs in the Fallopian fold of the broad ligament, the formation of the pocket in this case (No. 1) would be impossible. The ovary might disappear and the tube might run in the wall, but ought to open into the abdominal cavity.

If developed in the intra-uterine portion of Gärtner's duct, we would expect to have the Fallopian tube and the ovary intact on the outside of the sac, just the same as in mural pregnancy from the uterine portion of the Fallopian tube. How great value in diagnosis of mural pregnancy the fact has that the muscle of the uterus is continuous with the muscle of the sac I do not know; but in this case apparently only the layers of the surface of the uterus are continuous with those of the sac, and in mural pregnancy I would rather expect to have the deeper layers participate also.

In conclusion I shall proffer my thanks to the Society for the honorable task intrusted to me, and ask its pardon in that the material in question and the literature at my disposal have not enabled me to give a more satisfactory report of the matter.

ANTISEPSIS IN ABDOMINAL OPERATIONS; SYNOPSIS OF A SERIES OF BACTERIOLOGIC STUDIES*

WITH BAYARD HOLMES, M.D.

Synopsis of a Series of Bacteriologic Studies.—These investigations were undertaken to determine how far the necessary aseptic conditions had been secured and maintained in the abdominal sections performed by Dr. Christian Fenger. One case of another operator is brought in, to compare less thorough antiseptic precautions.

In order to estimate the results of these researches, you must know what preparations were made for the operation on the part of each concerned.

The Preparation of the Operating-room.—In the Emergency Hospital and in the County Hospital the walls and the floor and all the furniture were thoroughly washed with a 1 : 1000 sublimate solution on the day before the operation. The cracks about the windows and doors were stuffed with cotton, and the room closed to every one except the nurse that made the preparations.

To test the condition of the atmosphere in this room in the Emergency Hospital four plates of gelatin were exposed for forty-eight hours on the operating table August 24 and 25, 1886. After six days' incubation in the moist chamber, from 8 to 12 colonies of all kinds appeared on each square inch of surface. Most of these were molds, which grew very rapidly; some were micrococci and some bacilli. As less than 12 colonies developed to the square inch, it is probable, if the plates were exposed only an hour instead of forty-eight hours, not more than one colony would be found on each 4 square inches, so that the danger of atmospheric infection from falling germs would be very slight under similar conditions. The danger would be, no doubt, increased by the movements of the assistants and the increased circulation of air through the difference in temperature of the external and internal atmosphere when the room was in use.

The Preparations of the Operator and Assistants.—Each took a sublimate bath (1 :2000) and put on sterilized cotton suits. The hands and arms were then washed five minutes with warm water and green soap, and scrubbed with a brush, and then washed half a minute in a 1 :1000 sublimate solution. The patient received substantially the same treatment.

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* Jour. Am. Med. Assoc., 1887, vol. ix, pp. 444 and 470.

The Preparation of the Sponges, Silk, Instruments, Gauze, and Water.—The sponges were those prepared by Schorse, of Milwaukee. The silk was boiled an hour in a 5 per cent. carbolic acid solution, and in some cases afterward immersed in a solution of iodoform and ether and again sterilized by moist heat in a bottle stoppered with cotton. This was done by placing the bottle in a pail containing 1 inch of water and boiling for an hour. The instruments were boiled an hour in a 5 per cent. carbolic solution on the day before the operation and then dried. On the morning of the operation they were again boiled for a few minutes in a similar solution, and placed in trays of sterilized water for use.

The water was sterilized by boiling in large tin cans, each holding 2 or 3 gallons, for an hour or more on three successive days. The cans had tin covers, put on over a rim of cotton to stop the crack between itself and the can.

The culture-medium used for these investigations was sterilized, alkaline, peptonized beef-tea gelatin. Most bacteria will grow in this medium at the temperature of a living room. Answers have been sought through these investigations to the following questions:

1. Are the sponges sterile when rinsed out and ready for use? Pieces of each of the sponges to be used were cut off by the assistant who had the care of them, and put into the gelatin with sterilized forceps. Three or four pieces were put in a single tube. In this tube you see 3 such pieces surrounded and permeated by the transparent nutrient gelatin. Out of 25 sponges from 7 operations, only a single sponge was found infected with a single colony. Through attempted cultures from these prepared sponges and silk, answers to the following questions have been sought:

2. Are the sponges sterile when ready for use? After the sponges had been rinsed out in sterilized water three times, the assistant cut off small pieces from each of the sponges to be used with scissors, and they were put in a tube of liquefied gelatin beef broth. This tube contains 3 such pieces of sponge surrounded by the clear solid gelatin. Out of 25 sponges from 7 operations, only a single sponge was found infected with a single colony.

It appears that the sponges are sterile at the beginning of the operations, and if sterile, then, of course, aseptic. Five or six pieces of silk were usually taken from as many needles, and 1 inch cut off from each and put in a single tube of gelatin. More than 30 such pieces were examined from 9 operations, and not a single colony developed. In no case was the silk infected at the beginning of the operation.

3. Is the catgut sterile? (*Schorse's carbolized catgut.*) Several pieces at 4 operations were examined. In 1 case only did any colonies develop. In this tube you see 2 pieces of catgut at the bottom of the clear gelatin. Clinging to the side of one piece you can discover a small spheric white colony, and a little distance from it in the gelatin another similar colony. This catgut was from a new bottle of catgut used in operation 5 in a private house in the country. It is difficult to say how significant their presence is. They might arise from any one of the following causes:

The sponges were part new and part old, having been used in a previous abdominal section. After that operation they had been soaked a day in a strong solution of bicarbonate of soda, and washed out in a 5 per cent. solution of carbolic acid and hung away in a bag. On the day before the operation all the sponges were boiled in a porcelain kettle for more than an hour in a 2.5 per cent. solution of carbolic acid, and put into a jar and taken to the operating-room. The silk was boiled and carried in the same jar. The operator took a bath and put on perfectly clean clothes on the morning of the operation. The assistants were instructed to do the same. The hands and arms of the assistants were washed in soap and water and then in a sublimate solution 1 : 1000.

The material examined consisted of 4 sponges and 2 pieces of silk before the operation, after the sponges were rinsed out, and the needles threaded, and of 2 sponges after the operation and several inches of the thread used. All the material was infected except one piece of silk examined at the beginning of the operation. Every sponge had at least one colony of the hay bacillus, and one sponge after use showed more than 50 small white colonies in the clear gelatin in the upper part of the tube.

What influence the asepsis of the material has on the results of the operations as to death or recovery is a question far beyond the scope of these investigations. It would require a large statistical material of well-observed cases and more work than could be done by one observer. But it may be safe to conclude that it is desirable to work through an abdominal operation with perfect asepsis everywhere, if such a thing is possible. The above investigations have shown that such perfect asepsis can be attained. Thus, if we are ignorant of the extent of danger from non-sterile material, we are hardly justified in trusting to the innocence or innocuousness of such an uncertainty, while we can have the asepsis of the material an absolute guaranty against the dangers of infection.

OPERATIONS PERFORMED BY DR. CHRISTIAN FENGER

1. Dermoid of ovary. Emergency Hospital, November 9, 1886. Bursting of cyst into the abdomen during operation; irrigation; 1 sponge and 1 piece of silk infected after operation; 4 tubes used to examine 12 pieces of material. Recovery. Development of properitoneal abscess, which was opened in the sixth week. Complete recovery.

2. Cystosarcoma of left ovary. Emergency Hospital, November 30, 1886. Solid movable tumor 6 inches in diameter, only slightly adherent to abdominal organs; metastasis in peritoneum; some ascites present. Drainage; 6 tubes used to examine 11 pieces of material; 1 sponge before use and 1 sponge after use infected, each with a single colony. Recovery.

3. Radical operation for hernia. Emergency Hospital, January 18, 1887. Eight tubes used to examine silk and sponges and catgut; all sterile. Recovery.

4. Pyosalpinx. Emergency Hospital, January 19, 1887. The sac, adhering on all sides, ruptured in removal. Irrigation of abdomen; 14 tubes of nutrient gelatin used; all sterile. *Contents of cyst planted in solid human blood. Serum developed diplococci of very small size, which do not grow in gelatin*, probably gonococci. Death from acute sepsis within forty-eight hours.

5. Double dermoid. Private house, January 24, 1887. The tumor of the left side

had ruptured twenty years before, and produced an almost fatal peritonitis (?). This tumor was now large and adherent all around. The tumor on the right side was small and free; 9 tubes used with 25 pieces of material; 1 piece of catgut infected with 2 colonies; 1 sponge infected with a single colony. Death from shock within twelve hours.

6. Cyst of ovary. Emergency Hospital, February 3, 1887. Seven tubes used to examine 10 pieces of material; all sterile. Recovery.

7. Cyst of ovary. Emergency Hospital, March 22, 1887. Two tubes used to examine silk and sponges after operation only; all sterile. Recovery.

8. Malignant cyst of broad ligament. County Hospital, March, 1887. Four tubes used; all sterile. Death from uremia on the fifth day. Autopsy. Atrophic and dilated kidneys.

9. Proliferating cystoma of ovary. Emergency Hospital, March 24, 1887. Large and adherent; burst during removal. Irrigation of abdomen to remove cyst contents. Drainage; 5 tubes used, 12 pieces of material; only 1 sponge infected with numerous colonies. Death after thirty-six hours. Autopsy after six hours. Thrombosis of right ventricle. Bloody serum found in the peritoneal cavity in small quantity was added to nutrient gelatin. It remained sterile after two weeks' incubation.

Contrasted Case Performed by Another Surgeon in Which Less Successful Antiseptic Precautions were Used

Cystosarcoma of ovary. Private house, February 22, 1887. Very large, and adherent to omentum and abdominal wall. Drainage by means of 2 rubber drainage-tubes; 9 tubes used for silk, and sponges all infected except one, containing silk, before the operation. The sponges, after use, contained many—50 to 100—colonies. Each of the 8 infected tubes had at least one colony of the hây bacillus. Death on the third day. No autopsy. At each daily dressing there was evidence of some oozing from the drainage-tubes.

ing for congenital absence of the vagina: he made an H-shaped incision at the place of entrance, and having loosened an anterior and a posterior flap and made a vaginal canal in the usual manner, by dilatation with blunt instruments he turned the two flaps into the newly formed canal, and secured them in position with sutures. Heppner's plan of operating has never had many followers, because the flap thus made must necessarily be too short for the more extensive defects of the vaginal canal.

Credé, in 1883,* tried to remedy this difficulty by taking a sufficiently long and broad flap of skin from the labium majus (Fig. 46). In his introductory remarks he says: "It is remarkable how often it is reported that the result of the usual operation for atresia was nil, or in ufficient." In a case of acquired stenosis of the vagina caused by chronic ulcerative vaginitis the usual method of blunt dilatation had been tried in vain by renowned gynecologists. Credé, therefore, decided on a plastic operation, as follows: he loosened the left labium majus from above downward, leaving the base of the flap behind the vagina and in the left half of the perineum. The flap was 12 cm. long and 6 cm. broad, and when planted on the dilated vagina and united by sutures to the cervix, it healed without difficulty and relieved the patient from her sufferings, consisting of dysmenorrhea, pelvic pain, and a discharge which corroded the external genitals so as to cause constant pain and irritation. He states that three weeks after the operation the vagina was sufficiently large and the patient suffered no pain; that the hairs

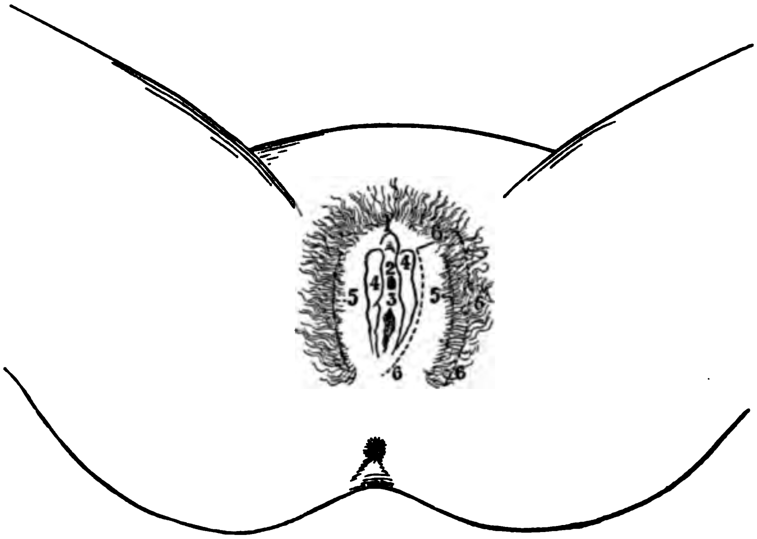

Fig. 46.—1, Clitoris; 2, urethra; 3, defective vagina; 4, 4, labia minora; 5, 5, labia majora; 6, incision for flap, consisting of left labium majus and its surrounding skin on the outside, and of the skin of the perineum.

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* "Heilung der Stenosis Vaginæ durch Einnähen eines Hautlappens," Arch. f. Gynäkologie, 1883, vol. xxii, p. 229.

on the flap implanted caused no disturbance, and the patient, who was fifty years of age, was restored to comfort.

Last year a case of extensive atresia came under my care, in which the usual methods of treatment had proved entirely inefficient. I consequently had to resort to some plastic operation.

It appeared to me that even Credé's perfected method did not meet all the requirements, inasmuch as the use of a single flap would not be likely to be sufficient to cover the walls of a canal like the vagina; further, it seemed to me desirable to have the vagina covered, not with skin, but with mucous membrane, if possible. To this end I operated in the following manner:

E. N., twenty-seven years of age, came under my care in Cook County Hospital June 30, 1886. Parents living and healthy. Had measles and scarlet fever during childhood, partial deafness following the latter disease. At the age of thirteen she began to have menstrual molimina, backache, and pain over the suprapubic region of a spasmodic character, and occurring at monthly intervals, but there never was any menstrual discharge. The free intervals between the molimina gradually diminished until she reached the age of sixteen, when she had pain most of the time and was often confined to her bed.

About a year later she noticed a tumor in the abdominal cavity, which gradually increased until it attained the size of a head. At this time, about eleven years ago, Dr. William H. Byford performed the operation for hematometra at Mercy Hospital. He found an absence of the lower two-thirds of the vagina, and made a passage from the vulva to the upper third of the vagina, and evacuated the retained menstrual fluid. The patient was up and about in two weeks, but a fortnight later was compelled to go to bed on account of fever and pain in the pelvis and suprapubic regions, where subsequently an abscess formed, which was opened above the pubes, and continued to discharge for several months. The menstrual flow did not appear until about a year and a half later, when it came on at regular intervals. It was always scanty and lasted only a few days.

For the last three months it has grown still more scanty, and the spasmodic pains have recurred in the back, down the thighs, and in the pelvis so severely that she is hardly able to get about. The last menstruation appeared in May, 1886, with hardly an appreciable flow.

Present Condition.—Patient is healthy looking, well nourished, and complains of pain in the pelvis and suprapubic region. Above the pubes on both sides are several nodular, retracted cicatrices remaining from the abscess openings of years ago. Pressure at this point causes pain, but no distinct tumor can be felt. The external genital organs present the following conditions: The mons veneris and labia majora are of normal shape and size, covered with the usual amount of blond hair. The clitoris is normally developed, and so are the labia minora, the upper half of the latter being about a square inch in size. The external orifice of the urethra is in the normal position, about ½ inch below the clitoris. Instead of the usual introitus into the vagina there is a shallow, funnel-shaped depression, consisting of hard cicatricial tissue with a smooth surface, and not covered with mucous membrane. The apex of the funnel at the depth of ½ to ¾ inch presents a narrow opening through which only a very fine probe can be passed in about 2 inches. Digital exploration in the rectum reveals, at a depth of 2 to 2½ inches, a round body the size of an orange, slightly movable, the upper end of which the finger could not reach. Knowing nothing of the exact condition at the time of the operation for hematometra, I supposed this tumor to be the uterus dilated by retained menstrual blood. Diagnosis: Atresia of vagina from congenital absence of the latter and retraction of the passage formed at the operation for hematometra.

I performed the usual operation for atresia of this kind, as recommended by Emmet and almost all other gynecologists, in the following manner: On August 3d the patient was anesthetized, brought on the table in the lithotomy position, the surroundings of the external genital organs having been shaved and disinfected. The hard cicatricial tissue at the entrance to the vagina was dissected away with scissors, a grooved director inserted in the narrow canal, and slight bilateral incisions made inward, sufficient to admit the end of the index-finger. A urethral sound was now introduced into the bladder and held by an assistant, and the left index-finger introduced into the rectum. The opening into the vagina was now dilated with the right index-finger, alternating with the metal handle of the scalpel. When the dilatation had extended inward about 2 inches, 2 ounces of pale pink, mucopurulent fluid escaped, and I could introduce a finger into the sac, which had thick, rigid walls and a corrugated, rough inner surface. The canal, which now admitted the finger, was dilated without difficulty outward to both sides, the loose connective tissue between the rectum and bladder offering very little resistance to the dilatation until a transverse diameter of 2 inches was obtained.

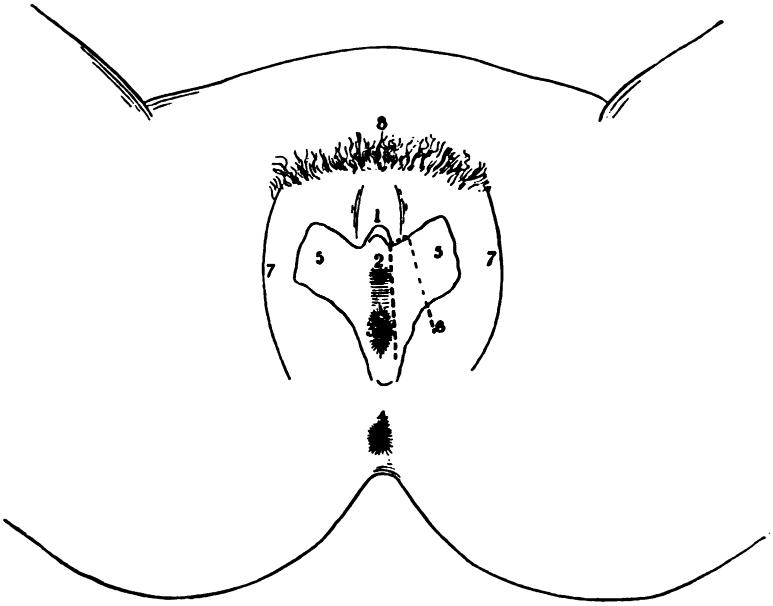

Fig. 47.—1, Clitoris; 2, urethra; 3. defective vagina; 4. anus; 5, 5, labia minora; 6, line of incision to liberate the labia minora; 7, 7, labia majora; 8, mons veneris.

Exploration through the rectum by the left index-finger with the right index-finger in the sac pulling the latter downward showed, above and behind the sac, a small body about the shape and size of a virgin uterus. The tissues of both parametria were somewhat thickened and rigid, so that I was not able to palpate the tubes and ovaries. As it was thus evident that the sac described above was the dilated upper portion of the vagina, I decided to enlarge the entrance sufficiently to permit the passage of a glass plug up to the vaginal portion of the uterus.

Two Simon's specula were then introduced, and showed a narrow entrance into the now empty sac. This entrance we were obliged to widen by radiating incisions through the thick wall before a glass speculum 1½ inches in diameter could pass into the sac. Digital exploration at the uterine end of the sac failed to show any distinctly shaped vaginal portion of the uterus.

The hemorrhage during the operation was not very considerable. The wound cavity was irrigated with bichlorid of mercury 1 : 4000; iodoform rubbed into the walls; a glass speculum introduced and held in place by a perineal antiseptic dressing.

The patient was kept in bed for two weeks, no high temperature, pain, or inflammation following the operation. In the fourth week the menses came with a medium amount of discharge, but no pain or other difficulties. During this period the glass plug was removed. At the end of the period, when the tube had been out for five or six days and the time had come for its reintroduction, I found that the newly formed vaginal canal had already retracted so as to admit only the index-finger, and the introduction of a larger glass plug caused her unbearable pain. I was, therefore, compelled to anesthetize her and repeat the forcible dilatation, which was accompanied by some hemorrhage, before I could introduce a glass plug of the same size as before.

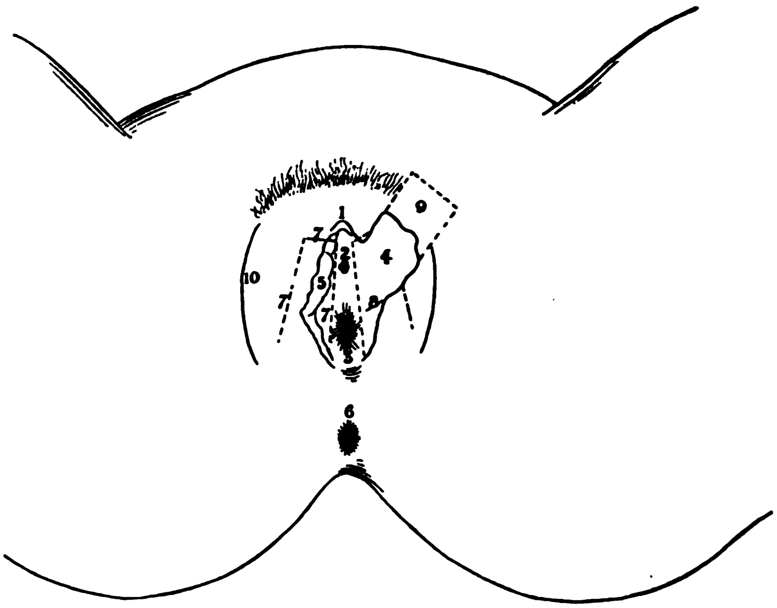

Fig. 48.—1, Clitoris; 2, orificium ext. urethræ; 3, fistulous opening through the cicatricial tissue of the defect of vagina; 4, left labium minus laid against the labium majus; 5, right labium minus *in situ;* 6, anus; 7, 7, 7, line of incision for lateral (labial) flap of skin; 8, part of incision dividing the labium minus so as to unfold it; 9, the unfolded labium minus; 10, labium majus.

This difficulty recurred at every subsequent menstrual period. I consequently determined to perform a plastic operation, with the expectation that if I could get a vaginal canal covered with skin and mucous membrane, the retraction would not recur. As Heppner's proposed flaps could be only comparatively short and entirely insufficient for a canal of this length, and as Credé's unilateral or posterior flap did not seem to me to fill the indications, at least so far as cohabitation is concerned, I resolved to try to use the labia minora, which in this patient were normally developed, for the bilateral flap operation.

This I performed on October 26th, assisted by Drs. van Hook, Davis, Black, and the surgical staff of internes in the hospital. The menses had just ceased. The patient was prepared in the usual manner, and placed upon the operating table in the lithotomy position. The contracted vagina was dilated as usual to its full size, and the smooth part of the cicatricial surface freshened by scraping with the sharp spoon, and thoroughly irrigated by bichlorid solution. The labia minora were now loosened by incisions (as shown in Figs. 47 and 48) namely, a median incision along the entrance to the vagina, upward along the side of the urethra to the clitoris. From this point a small transverse incision out toward the labia majora, and from here a lateral incision carried downward, backward, and outward, so as to form a base for the flap 1¼ inches in diameter at the lateral portion of the perineum. The whole of the labium minus was then loosened from the underlying muscles, forming a flap 1½ inches long. The upper quadrangular portion of the labium minus was then split lengthwise, and the anterior or median surface turned upward and outward, as shown in Fig. 48. By this procedure the flap was lengthened about 1 inch. The labium minus thus divided was, in its upper part, almost transparent, and so thin that I was somewhat afraid it would lose its vitality from insufficient blood-supply. My fears, as it afterward proved, were groundless.

Both labia minora having been prepared in the same manner, the two lateral flaps thus formed were turned into the newly formed vagina. The upper borders were stitched to the lateral margins of the cervical portion of the vagina, and the long lateral borders of the flaps secured by a few chromicized catgut sutures to the tissue of the lateral wall of the newly formed vaginal canal, anteriorly and posteriorly, so as to prevent them from folding longitudinally.

The vaginal cavity was now irrigated, thoroughly rubbed with iodoform, and packed with iodoform gauze. The loss of substance at the place of the transplanted flaps was without difficulty united by securing the movable skin of the labium minus by sutures to the mucous membrane at the place of the median incision. A flexible rubber catheter was left permanently in the bladder, and an iodoform dressing placed over the vulva.

The after-treatment was uninterruptedly aseptic, and a week later, when the iodoform dressing was removed, complete union by first intention was found to have taken place, and the flaps were alive and everywhere adherent. Vaginal and external iodoform gauze dressings were applied for another week, and then a glass plug 1 inch in diameter was introduced. This was replaced a week later by a plug 1¼ inches in diameter, and still later by one 1½ inches in diameter, which was introduced and kept in for several hours daily during the following months. At the subsequent menstrual periods, during which the plugs have been left out, there has been no appreciable retraction of the vagina, and after the period the patient has been able to introduce the plug without either pain or hemorrhage.

The patient kindly consented to come before the Gynecological Society for examination, and the members of the Society were able to convince themselves that this newly formed vagina is wide, elastic, smooth, and covered with mucous membrane of some secretory power.

There can be no doubt that a plastic operation for atresia of the vagina is superior in its result to the old method of simple dilatation without transplantation of skin and mucous membrane on the wounded surfaces. It is desirable to have the walls of the newly formed vagina as similar to a normal vagina as possible. If a covering of mucous membrane, as from the labia minora, can be had, it is preferable to a flap of skin from the adjacent parts.

It is possible that cases of defect of the vagina may be complicated by defect of the external genital appendages, and that no labia minora exist. In such cases I recommend a bilateral flap of skin as preferable to Credé's unilateral flap, but in cases in which the nymphæ exist, a bilateral flap formed of them is preferable, can be had of sufficient size, and be used with almost perfect results.

THE OSTEOPLASTIC RESECTION OF THE FOOT, AS DEVISED BY WLADIMIROFF AND MIKULICZ*

ONE of the characteristics of aseptic surgery is conservatism; this is especially seen in the hesitancy with which, in certain cases, modern surgeons resort to amputations, and in their endeavors to devise less mutilating operations. At the present day joints are excised, partially or totally, and portions of the tarsus or carpus are removed in cases where, in former days, nothing short of an amputation would have been thought of.

The osteoplastic resection of the foot has lessened, and is destined still further to lessen, the number of cases in which amputation of the foot above the malleoli is called for. The operation is indicated when the soft or osseous structures of the heel are destroyed so extensively that there is not sufficient skin or bone left on which the weight of the body can rest. It will thus be had recourse to in certain cases in which Pirogoff's operation on Sédillot's évidement cannot be performed, *e. g.*, where there is tuberculosis of the body of the os calcis, with or without fistulous openings, or where there is extensive loss of cutis on the heel. In such cases Pirogoff's operation is impracticable, for to be successful the posterior half-inch or inch of the calcaneum must necessarily be healthy, and the skin of the heel must be reasonably well preserved. Cicatricial tissue, as is known, is of low vitality; it is unable to endure the pressure and friction incident to walking; it is thinned by "usure," becomes necrotic, and the omnipresent pus-microbes gain admittance to the denuded tissue.

Sédillot's évidement also has its limitations. Where the operation leaves large cavities, in a patient older than ten years, the cavities will, as a rule, never fill with bone. If the greater part of the spongy substance of the calcaneum be removed with a gouge,—if, as Sédillot says, a mere shell of bone be left,—the calcaneum will, in many instances, be unfit to walk upon; it is too weak, and its spongy substance is but imperfectly reproduced. In such cases the only operation by which, formerly, the patient could be relieved was amputation above the malleoli.

In 1872 a Russian surgeon, Wladimiroff, read before the Medical Society of Kasan, Russia, a paper on several new osteoplastic operations which he had performed on the lower extremity. Among them he described an operation by which he formed, according to his phraseology, an artificial pes equinus. He had had a case where there was chronic destructive disease of the astragalus and calcaneum, with loss of skin on both sides of the lower astragalus joint. The cuboid, scaphoid, and remaining bones of the foot were sound. Being desirous of having the patient walk on his foot, of preserving the sound parts of the member, and of obtaining a clean wound which would be likely to heal by first intention, he conceived of the following operation, which he carefully studied and practised on the cadaver:* He removed the astragalus and calcaneum with the skin covering the heel, and united the cut surfaces of the scaphoid and cuboid bones with the tibia and fibula; the last two bones he cut just above the malleoli. Wladimiroff operated March 2, 1871, and published the case on February 11, 1872. He stated that his patient, a boy of fifteen, could walk without a cane, and that he walked well with a cane. As this case was published in the Russian language, it was almost as good as lost to the medical profession in all countries except Russia.

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* Jour. Amer. Med. Assoc., 1887, vol. viii, p. 113.

In 1881 Mikulicz, of Vienna, having no knowledge of Wladimiroff's case, devised an operation similar to, or rather identical with, that of the Russian surgeon.† As the profession became acquainted with the operation through Mikulicz, his name has been attached to it. At the Eighth International Congress in Copenhagen, however, Professor Sklifossoffsky, of Moscow, stated that Mikulicz's operation had been known in Russia for some years past, and that the idea of forming an artificial pes equinus was due to Wladimiroff. Mikulicz's case is as follows:

> A man of twenty-two years suffered from a serpiginous ulcer which, destroying the skin, had extended from the malleoli around the heel to the anterior half of the sole of the foot. The skin on the dorsum of the foot remained intact. Mikulicz incised the ankle-joint, removed the astragalus and os calcis with the integument, and sawed a disc off the scaphoid and cuboid bones. The steps of the operation were as follows: An incision was made across the sole of the foot from the tuberosity of the scaphoid to a point a little posterior to the tuberosity of the fifth metatarsal bone. From the ends of this incision he cut upward and backward on both sides of the foot as far as the malleoli, and made a fourth incision between these two points posteriorly to the joint. He then disarticulated at the ankle, cutting from behind, and brought the foot into dorsal flexion; the astragalus and os calcis were detached from the soft parts on the dorsum of the foot, and Chopart's joint opened from above. Having obtained with a saw cut surfaces at the ends of the tibia and fibula above the malleoli, and cut surfaces at the posterior parts of the cuboid and scaphoid bones, he brought these surfaces into apposition, and thus placed the foot in the position of a pes equinus. The wound healed in two months. In four months his patient walked without a cane in a boot constructed for the purpose. A few weeks later he walked without the boot and was able to bear his whole weight on the resected foot.

In order to illustrate the operation I will give the history of my case, and later I will discuss the indications for the operation, the method of performing it, and its results:

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* Fischer: "Zur osteoplastischen Resection des Fusses durch Wladimiroff-Mikulicz," Deut. Zeitschr. f. Chir., 1886, vol. xxiii, p. 162.

† Mikulicz: "Eine neue osteoplastische Resectionsmethode am Fusse," Langenbeck's Arch. f. klin. Chir., 1881, vol. xxvi, p. 494.

Synopsis.—Traumatic injury to the right heel, resulting in chronic progressive osteomyelitis and periostitis of the os calcis and the talus of ten years' duration. Osseous ankylosis of the posterior talus joint and of Chopart's joints; fibrous ankylosis of ankle-joint. Ulcerative destruction of the skin on the posterior surface of the heel. Repeated local operations on the calcaneum without permanent benefit. Abscess and subsequent intractable fistulas on the dorsal side of the talus, leading to diseased bone in the sinus tarsi. Osteoplastic resection of the foot in accordance with Mikulicz's description. Consolidation of the foot in good condition. No relapse of the disease in the bone; forcible extension of the toes into the equinus position. Rupture of skin at the base of the first phalanx of the hallux. Subsequent inflammation of the scar. Excision of the scar and transplantation of skin from the planta pedis. Healing by first intention. Patient is able to walk without cane, and can bear the whole weight of his body on the right foot.

Christian Jebsen, aged twenty-eight, laborer, gives the following history: His father was troubled for many years with annually recurring attacks of facial erysipelas; his mother suffered from a chronic pulmonary disease and varicose ulcers of the left leg. Patient's health was good up to his eighteenth year. At that time patient followed the occupation of a sailor. On board ship he received an injury in his right heel from a pointed iron rod which was thrown at him by the captain of the vessel. The point of the rod entered the os calcis posteriorly, and passed forward and downward for about ½ inch. The wound suppurated one year, during which time patient was in poor health. He was confined to his bed most of the time. Two months after closure of the wound the cicatrix opened; this, together with swelling and tenderness around the os calcis and its articulations, rendered the patient an invalid for three years. The wound healed again, and swelling and tenderness diminished so far as to enable the patient to wear a boot and to walk without suffering much pain. Six months later a sinus showed itself, through which a probe could be passed into the bone. This sinus closed after several months. Patient then came to America. He had been here but five months when again a fistula began to discharge. In 1883 he was admitted to the Cook County Hospital, where the sinus and a cavity which was found in the posterior part of the os calcis were scraped with a sharp spoon and gouge. In three months the cavity filled and the wound closed. Patient was discharged in November, 1883. He was able to walk some, but movements of the foot were limited and painful. Swelling and tenderness remained. In the spring of 1884 he returned to the hospital with a running sinus. Dr. Verity removed part of the os calcis, excised the cicatrix, and united the skin over the remainder of the bone. The wound did not heal; six months after the operation an abscess formed on the dorsum of the foot over the astragalus.

Patient now passed into my care. I found him pale and poorly nourished; lungs, heart, and abdominal organs healthy; urine normal. The right foot was fixed in plantar flexion at an angle of about 30 degrees. There appeared to be complete ankylosis in all the joints from the ankle to Chopart's articulation. On the posterior and inferior surfaces of the heel there was an adherent cicatrix, roundish in shape, and about 1½ inches in diameter. The center of this cicatrix presented a granulating spot where a probe could be passed to the roughened surface of the calcaneum. The soft parts around the ankle and on the dorsum of the foot were swollen and indurated. An abscess on the dorsal side of the astragalus was opened, and about a tablespoonful of pus evacuated. The probe discovered roughened surfaces of bone in the sinus tarsi. I drained the abscess, placing a tube transversely behind the flexor tendons; scraped the granulating spot on the heel, and applied an iodoform dressing. The wound was treated for four months with injections of tincture of iodin and of a solution of iodoform in ether. As the condition remained the same, it became necessary to decide whether the foot should be amputated above the ankle or resected according to the method of Mikulicz. The loss of skin on the heel and the diseased condition of the bone put Pirogoff's operation out of the question. As the patient wished to retain as much of his foot as possible, I determined on Mikulicz's operation, which I performed upon him December 31, 1884.

After thorough disinfection of the foot and leg as high up as the knee, patient was anesthetized, turned over on his stomach, and Esmarch's elastic bandage applied. As there had been an abscess on the dorsal side of the astragalus, and as there remained considerable infiltration of the tissues around the flexor tendons and in the neighborhood of the arteria dorsalis pedis, I dared not rely upon this artery alone for the blood-supply of the foot. I desired to preserve the posterior tibial artery as far down as I possibly could—at all events, down to its division into the internal and external plantar arteries. I was consequently compelled to make my incisions somewhat different from those made by Mikulicz.

I began my internal incision in the planta, ¾ inch from the inner margin of the sole, and ¾ inch posterior to the tuberosity of the scaphoid. From this point I curved my knife, cutting down to the bone, backward and upward over the internal surface of the os calcis, below the sustentaculum tali of the inner border of the tendo Achillis; thence upward along the tendon to a point posterior to the ankle-joint. In making my external incision I commenced 1 inch behind the tuberosity of the fifth metatarsal bone in the margin of the foot; I then cut upward and a little backward, running the incision ½ inch anterior to the external malleolus, over the external surfaces of the processus anterior calcanei and the body of the astragalus to the ankle-joint. Between the upper and lower ends of these incisions I made transverse incisions across the sole and behind the ankle-joint respectively, cutting down to the bones. The superior transverse incision dividing the tendo Achillis gave a ready access to the ankle-joint. The soft parts of the dorsal flap were detached from the subjacent bones with a periosteal elevator, which was kept between the periosteum and bone in order to avoid injuring the vessels. The disarticulation at the ankle-joint was accomplished with some difficulty, as a complete osseofibrous ankylosis was found to exist between the astragalus and the tibia. Having disarticulated, I pushed the heel downward and further detached, with the periosteal elevator, the anterior soft parts from the astragalus. From inactivity and the proximity of a suppurative inflammation the bones had undergone fatty atrophy (adipose osteoporosis); they were so friable as to break in or near Chopart's joint, which was completely ankylosed. The posterior parts of the scaphoid and cuboid bones were now gouged away as far as diseased; after healthy bone was reached a thin disc was sawed off each bone in order to obtain even and smooth bony surfaces. The ends of the tibia and fibula were sawed off ½ inch above the joint. The sinuses that existed in the dorsal flap were scraped with the sharp spoon. Esmarch's bandage was now taken off, and the hemorrhage stopped. After this the cut surfaces of the scaphoid and cuboid were brought into apposition with the corresponding surfaces of the tibia and fibula, and held in place by means of two silver-wire sutures. The wound was lightly dusted over with iodoform, the soft parts were united with deep catgut and superficial silk sutures, and the necessary drainage was provided for. The foot and leg, half way up the thigh, were enveloped in an iodoform Lister dressing and immobilized with plaster-of-Paris bandages.

The soft tissues on the inner side of the foot naturally formed a bulky mass. I preferred to leave this and to allow it to undergo atrophy in the future. By diminishing its size I should have run the risk of losing important branches of the posterior tibial artery. The circulation in the distal portion of the foot was perfect; after removal of the elastic constrictor blood was seen to ooze from all parts of the peripheral side of the wound.

The wound healed (definitively) in four months. During this time a few small abscesses formed in the just-mentioned mass of soft parts on the inner side of the foot. One also appeared behind the tibia. These abscesses being promptly opened and drained, caused no further trouble.

As the toes of the foot were fixed in semiflexion, and as they possessed but little mo-tuberculosis of the astragalus and os calcis with implication of a neighboring joint. (3) Extensive destructive ulceration of the skin on the heel.

As to the first indication, it is to be remarked that the operation, as far as we know, has not as yet been performed in a case of acute traumatic injury of the heel.

The second indication has most frequently led to the operation, it being present in 13 out of the 19 cases reported. As the skin of the heel was intact in these cases, the question arises whether it would not have been preferable to make an extensive atypical resection of the tarsus. The latter operation does not alter the position of the foot—it allows the patient to walk on the planta. Opinions differ in regard to this question. Most of the older writers, as Hüter, König, Czerny, and Billroth, advise against resection of the tarsus. Lately, however, Kappeler, in Germany, and Connor, in America, have taken up and, in able papers, revised the subject of resection of the tarsus; both come to the conclusion that a good functional result may be obtained after removal of the tarsus, even when the operation is combined with a resection of the ankle-joint, *i. e.*, with a removal of the lower ends of the tibia and fibula. It may thus be doubted whether such cases as the 13 mentioned call for Mikulicz's operation, and whether his second indication is not better met by a partial, or even a total, resection of the tarsus.

Mikulicz's third indication is the only one which, as appears to me, must be indisputably accepted as good. Where there is extensive ulceration of the skin covering the heel, nothing but a cicatrix will form, and a cicatrix under the heel cannot bear the weight of the body, and will always ulcerate under the pressure it is subjected to in walking. As both Syme's and Pirogoff's operations require that the skin on the posterior flap be healthy, the osteoplastic resection of the foot is the only operation by which a supramalleolar amputation can be avoided.

If, in the course of time, the osteoplastic resection of the foot should prove superior to excision of the tarsus, to Syme's and to Pirogoff's operations, in its functional results, the indications for the operation will be viewed in a different light.

STEPS OF THE OPERATION

1. *Incisions.*—Mikulicz made a transverse incision across the sole from the tuberosity of the scaphoid to a point a little behind the tuberosity of the fifth metatarsal bone. Schattauer cut ¼ to ¾ inch anterior to this, running his incision over the cuneiform and cuboid bones. From the ends of the transverse cut incisions were made on the tibial and fibular sides of the foot, upward and backward as far as the malleoli, between which two points the knife was carried around the ankle-joint posteriorly. The tibial incision from the tuberosity of the scaphoid to the internal malleolus inevitably divides the posterior tibial artery, or rather its plantar branches. This leaves but the anterior tibial artery

to supply the foot with blood. Mikulicz, before he did his first operation, doubted that the blood-supply of the foot would be sufficient. He was, however, relieved of his anxiety when, after the removal of Esmarch's bandage, he saw the cut ends of the plantar arteries bleed freely. As I said above, I likewise feared for the safety of my patient's foot, in which there existed fistulous openings, hard induration, and infiltration of the soft tissues surrounding the anterior tibial artery. That such apprehension was well founded may be seen from Sordina's case, in which, four days after the operation, gangrene of the foot necessitated its amputation. It is, therefore, necessary to preserve some branches of the posterior tibial artery. This can be done by altering the incisions of the operation in the following manner:

Instead of cutting clear across the planta, the anterior transverse incision may be begun ¾ inch external to the tibial border of the foot. The tibial incision may then be made from this point, not upward to the internal malleolus, but almost horizontally backward over the tibial surface of the os calcis, below the sustentaculum tali, to a point 1 inch posterior to the sustentaculum; then it may be continued upward along the tibial border of the tendo Achillis to the posterior side of the ankle-joint. By this incision we may hope to save the internal plantar artery, whose assistance in supplying the foot with blood seems essential. This low incision is somewhat inconvenient to the operator; he meets with greater difficulties in getting at the ankle-joint and Chopart's articulation than he does when Mikulicz's incision is made. This difficulty, however, is overcome partly by separating the soft parts subperiosteally from the calcaneum and astragalus with a periosteal elevator (flat gouge), partly by bringing the external or fibular incision more upward toward the dorsum of the foot, so as to have it terminate about ¼ inch anterior to the external malleolus. This incision does not imperil the safety of the anterior tibial artery. The upper and lower transverse incisions will be about of the same lengths as they are when Mikulicz's directions are followed; there will be sufficient working space to get at the joints.

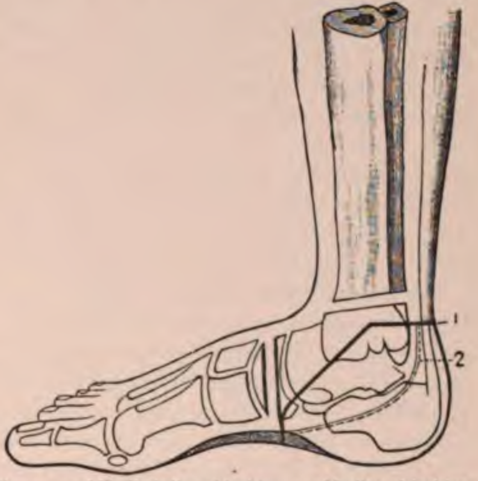

Fig. 50.—1, Mikulicz's line of incision. 2, My line of incision.

2. Disarticulation.—The disarticulation at the ankle had better be done first. Wladimiroff disarticulated first at Chopart's joint. By beginning at the ankle we gain more room for separating the dorsal cially in the sheaths of the tendons. The tuberculous tissue must at once be removed. That an extensive secondary operation may be done and the final result still be good is learned by Kümmel's case. Four months after a typical Mikulicz operation Kümmel took away the tarsus, part of the metatarsus, and additional pieces of the tibia and fibula. The wound healed by first intention. In five weeks his patient was able to walk in a plaster cast, and in five further weeks he walked in a shoe for four hours without suffering any pain. In Fischer's case the tuberculosis returned eight months after the operation. He removed what remained of the cuboid and the second and third cuneiform bones. His patient walked in a boot, with the aid of a cane, in six months. It is also stated that he could walk up and down stairs. The duration of the after-treatment in the different cases, from the time of the operation to the time when the patients began to walk, was as follows: In one (13), five weeks; one (17), seven weeks; three (2, 4, 9), two months; three (2, 7, 19), four months; three (12, 15, 16), six to seven months.

Prognosis and Results.—As yet there has been no death attributable to the operation. Two patients died of pulmonary tuberculosis, one six and one eight months after the operation (Cases 4 and 8). Both of these patients had walked on the foot, and, consequently, the operation may be said to have been successful. Three of the operations published were failures, as amputation above the malleoli became necessary. In two of these cases (6 and 14) the disease relapsed, and in one (17) gangrene of the foot set in. The patients, however, did not die.

It is thus seen that the osteoplastic resection of the foot is not attended by greater danger than the other operations in this locality. As the 19 operations published were done with antiseptic precautions, it would, of course, be rash to conclude that the mortality of Mikulicz's operation is less than that of excision of the tarsus, or of Pirogoff's or Syme's operations. The statistics of the latter operation undoubtedly owe their death-rate to preantiseptic surgery.

It cannot be said that the final functional result of the operation has, as yet, been well ascertained; most of the cases were published a relatively short time after recovery from the operation, and Fischer rightly remarks that we cannot judge of its value before we have a large number of cases before us. The object of the operation is to enable the patient to walk on his foot without any pain; to enable him to bear the whole weight of his body on the walking surface. This object was accomplished to perfection in 3 cases (2, 3, 13), and fairly well in 9. In this respect the results of the operation are far superior to those of supramalleolar amputations. It is Fischer's opinion that Mikulicz's operation gives better results than Pirogoff's, because after the former the walking surface is at least one-third larger than after the latter and because the toes give a certain "elasticity" to the gait. Closer comparison of the results of the two operations is as yet needed to confirm the correctness of this opinion. Mikulicz did not intend his operation to take the place of Pirogoff's or Syme's, although it seems that in some of the 19 cases reported the question might have arisen whether excision of the tarsus, or Pirogoff's or Syme's operations were not respectively indicated.

From the facts which I have collected and stated above I think it is justifiable to draw the following conclusions:

1. The osteoplastic resection of the foot, as devised by Wladimiroff and Mikulicz, has a legitimate place in the surgery of the foot. It gives functional results superior to those of supramalleolar amputation.

2. Destruction of the soft parts of the heel is an indisputable indication for its performance.

3. In tuberculosis of the ankle-joint with tarsus atypical excisions may be done, as advised by Connor and Kappeler, or Pirogoff's or Syme's operations. It is doubtful whether these operations, in cases permitting the choice, should be abandoned in favor of the osteoplastic resection. This question can be answered only after further observations have been made as to the permanent cure of the disease by the operation, the duration of its after-treatment, and its final functional results.

4. The results so far recorded allow of a choice between the osteoplastic resection and the operations mentioned, for the purpose of determining its value as compared with that of the older operations.

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TABLE OF OPERATIONS.

No.	Operator.	Year.	Sex.	Age.	Disease.	Course.	Death.	Result.
1	Wladimiroff.	1871	Boy.	15	Tuberculous caries of talus and calcaneus; tuberculous ulcers on both sides of the joint.	Recovery.	..	After twelve months walked well with a cane; able to walk without cane. Lengthening.
2	Mikulicz.	1886	Man.	22	Serpiginous ulcer (syphilis) on calf of leg, on heel and posterior half of plantar surface of foot. Bones and joints healthy.	Wound healed in two months.	..	In four months walks without cane and without boot. In six months does hard work; can walk one hour. Lengthening, 1½ cm.
3	Socin (reported by Burchardt).	1881	Girl.	22	Caries.	Healed rapidly.	..	In two months walks with cane; later she works in the field; two years later no fistula. Lengthening, 1½ cm.
4	Mikulicz.	1881	Woman.	27	Tuberculosis of posterior astragalo-calcaneal articulation. Évidement and removal of a sequestrum of no avail.	Healing by first intention.	Six months later, of pulmonary tuberculosis.	In two months commenced to walk. Lengthening, 1½ to 2 cm.
5	Sklifossoffsky (Moscow).	1882	..	30	Caries.	Recovery.	..	When reported in 1882 did not walk very well.
6	Lümniczer (reported by Haberern).	1882	Boy.	18	Tuberculosis of the talus, calcaneus, and malleoli and the joints from ankle to Chopart's articulation. Fistulas and fungous ulcers on the skin of the heel. Syme's and Pirogoff's operations impossible.	Relapse of the tuberculosis in the wound.	..	Amputation above the malleoli; recovery five months after the operation.
7	Mikulicz.	1883	Boy.	16	Tuberculosis, traumatic, of the posterior astragalocalcaneal articulation. Numerous fistulous openings through skin of heel. Évidement of cuboid and scaphoid bone at the operation.	Healing by first intention under two dressings.	..	In four months walks with boot and cane fairly well. In six months solid ankylosis. Can walk without boot, but must use cane. Can walk in boot without the cane. Lengthening, 1½ cm.
8	Lauenstein.	1883	Woman	32	Tuberculosis of the talus, calcaneus,—upper posterior part,—and internal malleolus. Évidement. Relapse in ankle and posterior astragalocalcaneal articulation.	Healing of wound in three months.	Eight months later, of pulmonary tuberculosis.	The stump was painless and could bear some weight.

9	Lauenstein.	1883	Man.	25	Tuberculosis in posterior astragalocalcaneal articulation. Évidement. Relapse in ankle-joint. Abscess in plantar side of foot.	Healing in one and one-half months.	. .	In two months can walk without pain. In three months works as a plasterer in boot. Lengthening, 3 cm. Five months later walks four hours without pain.
10	Mikulicz.	1883	Man.	50	Tuberculosis of talus and calcaneus.	Healing.	. .	Walks fairly well with cane; no difference in length visible when he walks.
11	K. Roser.	1883	. .	. .	Caries.	Recovery.	. .	Good functional result.
12	Kümmel.	1883	Woman.	38	Tuberculosis of the calcaneus. Extirpation. Relapse. Extirpation of the talus and malleoli. Relapse.	Healing of wound; relapse four months later; removal of the rest of the tarsus, part of the metatarsus, and an additional piece of tibia and fibula.	. .	In seven months after last operation can walk with a plaster cast. Lengthening, 6 cm.
13	Schattauer.	1884	Girl.	10	Tuberculosis of ankle-joint and swelling of posterior part of the foot; fistulas below the external malleolus. Tuberculosis pulmonum insipidus; fever; emaciation.	Healing by first intention.	. .	In five weeks walks in plaster cast. In five months walks in a common shoe for hours without pain; both legs of equal length.
14	Schattauer.	1884	Boy.	9	Tuberculosis of ankle and posterior astragalocalcaneal articulation and along the tendo Achillis.	Relapse of the tuberculosis.	. .	Amputation above the malleoli. Recovery.
15	G. Fischer.	1884	Girl.	18	Tuberculosis of posterior astragalocalcaneous articulation. Fistulas. Évidement. Relapse.	Relapse of tuberculosis after eight months. Removal of cuboid and second and third cuneiform bone.		Six months after last operation can walk slowly without boot Walks well with boot and cane. Mounts stairs.
[illegible]	[illegible]	1884	. .	. .	Cicatricial contraction of the foot in the position of equinovalgus, subsequent to a badly treated suppurating fracture above the malleoli.	Healing in three months.	. .	Seven and one-half months after the operation walks very well with boot. The leg operated upon is 3½ cm. shorter than the other.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Caries of the tarsus involving the ankle-joint.	Gangrene of the foot on the fourth day.	. .	Amputation above the malleoli. Recovery.

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No.	Operator.	Year.	Sex.	Age.	Disease.	Course.	Death.	Result.
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19	Chr. Fenger.	1885	Man.	28	Chronic traumatic osteomyelitis for ten years. Ankylosis of the joints from ankle to Chopart's articulation. Fistulas leading to suppurating bone in the sinus tarsi. Ulcerating cicatrix on posterior and lower surface of the heel. Évidement and plastic operations twice. Relapse.	Healing definite in four months. In six months toes dorsal flexed: twelve months after the operation plastic transplantation of skin from planta, healing in four weeks.	..	Fifteen months after the operation can walk without boot and cane and bear the whole weight on the foot. Solid ankylosis. Lengthening, 5 cm.

VERTEBRAL ARTERIAL LIGATION IN VERTEBRAL ANEURISM*

THE diagnosis of vertebral aneurism is obscure, in the great majority of cases; that is, it is often very difficult to decide whether the pulsatory swelling in the lateral region of the neck is due to an injury of the vertebral artery, on the one hand, or of the common carotid or one of its branches, on the other. The only means of determining whether an aneurism in this region is supplied by the carotid system or the vertebral artery is, as is well known, alternate, isolated compression of the vertebral and common carotid arteries.

The vertebral artery may be compressed against the cervical vertebræ below the carotid tubercle, but in this place pressure is likely to occlude both the common carotid and the vertebral arteries.

Above the carotid tubercle, that is, above the place where the vertebral artery enters the canal, it is possible, by pressure, to occlude the common carotid alone. While in the majority of cases this will be conclusive, it is not always reliable, since the vertebral artery may enter the canal at the fourth or fifth instead of the sixth cervical vertebra. It is, hence, not only always difficult, but it may be impossible, to locate the vessel supplying the aneurism.

If the vertebral artery has been found to be the vessel supplying the aneurism, three procedures suggest themselves: First, external compression; second, vertebral artery ligation below the carotid tubercle; third, the radical operation, that is, the opening of the sac, removal of the clots, and stoppage of the hemorrhage by ligation or compression.

The first two methods are unreliable, but still direct pressure has succeeded in stopping the pulsation and the patient has recovered. The majority of patients cannot endure pressure sufficient to cure the aneurism, on account of the excessive pain, but this procedure should, of course, be tried before resorting to more radical measures, since cases may occur in which either the arterial wound is so small or the local conditions so favorable that absolute immobility of the parts may cure the aneurism.†

The central end of the vertebral artery below the carotid tubercle has not been ligated in any hitherto reported successful cases, although it has been tied here for other purposes.

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The radical operation has finally to be resorted to when pressure fails to cure the aneurism. In the course of the artery through the canal of the transverse processes of the cervical vertebræ, it has been found so far impossible to apply a ligature, and consequently the hemorrhage in the exposed cavity of the traumatic aneurism can be checked only by plugging the cavity with tampons so as to occlude the arterial opening. This treatment was successful in Kocher's case, in which pulsation and hemorrhage resulted after a punctured wound in the region of the fifth and sixth cervical vertebræ. When he had laid open the cavity, he could see both ends of the divided vertebral artery, but was unable to seize and ligate them. The cavity was plugged with tampons soaked in iron perchlorid, and, despite an attack of erysipelas, the patient recovered.

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Dr. J. Mason Warren,* of Boston, reports the case of an eleven-year-old boy who received a gunshot wound of the vertebral artery, followed by violent hemorrhage. The next morning Dr. Warren resected a portion of the transverse process of the second or third cervical vertebra. The hemorrhage now recurred; systematic plugging with bits of sponge was followed by recovery of the patient.

As shown in the following successful case, the artery can be ligated between the occiput and the axis, and is preferable to plugging, since it is as safe as the latter is unsafe. As Vischer † has said, ligation at this point is difficult, since that "part of the artery between the occiput and the transverse process of the first and second cervical vertebræ is not accessible for direct ligation, even when part of the sternocleidomastoid muscle has been removed."

As will be seen from the history of the case, my patient came near dying on the table, and lost so much blood that immediate transfusion was imperative. It is, however, possible that ligation at this point might be facilitated by previously cutting down upon and securing the central end of the vertebral artery below the carotid by a loop, to be used for compression during the operation.

G. C., aged nineteen, cook, robust and well nourished, had always enjoyed good health up to January 6, 1881, when, while intoxicated, he was shot in the neck with a 32-caliber revolver. A large stream of blood spouted from the wound, and in fifteen minutes his face around his lower jaw became so swollen that he was unable to open his jaws more than ½ inch. On admittance to the Cook County Hospital an external bullet wound was found to exist 1 inch external to, and to the left of, the posterior nuchal median line, on a line with, and 2 inches behind, the mastoid. Considerable swelling existed in the left parotid region, extending forward upon the masseter and around the left eye, where it was evident, from the bluish color of the skin, that the tissues were infiltrated with blood. The mouth could be opened only ½ inch. In the left half of the floor of the mouth was a bluish-red swelling. There was constant severe pain in the region of the swelling, especially around and behind the left angle of the lower jaw. The bullet was not found. Five days later the patient, while straining at stool, felt something give way behind the angle of the jaw. This was followed by intensely agonizing pain, accompanied by decided pulsation of the left subauricular region. Four days later a decided aneurismal bruit was detected over this. As there could be no doubt of the existence of a traumatic aneurism at this point, Dr. E. W. Lee ligated the left common carotid artery. Two weeks later the bullet wound had entirely, and the operation wound had nearly, healed. The patient felt well, with the exception of a slight headache and slight sensation of pulsation below the left mastoid process. No aneurismal bruit was detectable on stethoscopic examination.

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* Surgical Observations, with Cases and Operations.

† Billroth and Lücke: Deutsche Chirurgie.

Three days subsequently, while undergoing cross-examination in court, the sensation of pulsation increased, and, on return to the hospital, a decided thrill but no bruit could be detected behind and below the left mastoid process. By February 9th the pain and pulsations had markedly increased. As it was obvious that a traumatic aneurism had recurred and was endangering life, I decided to make the radical operation, and began by securing the external carotid. An incision was made, 3 inches in length, along the entire upper half of the sternocleidomastoid, the tissues were carefully separated, a careful watch kept for the pulsating vessels around the border of the pulsating tumor, with a view to ligating them before opening the aneurismal sac. When pulsation on pressure in various places had been apparently felt, and the aneurismal pulsations seemed to cease, an aneurismal needle, armed with heavy aseptic silk, was passed successively around the area of the tissues involved, and ligature made *en masse*, but in vain.

I then determined to lay open the sac and catch up the supplying artery *in loco*. A transverse incision, 2½ inches in length, was made, extending from the upper end of the former incision backward from the mastoid process through the skin and insertion of the sternocleidomastoid, in order to secure the posterior occipital artery, possibly the source of the aneurism. On removal of the sternocleidomastoid the pulsations were more markedly felt. After a thin layer of the deep nuchal muscles had been cut through, the aneurismal sac was opened and found filled with dark clots, on removal of which arterial blood spurted out. This hemorrhage could be controlled only by pressure on the bottom of the cavity at its deepest part. The *squama ossis occipitis* was found to be denuded, and in the internal wall, formed by the atlas and axis, some splinters of bone were felt. The tissues were cut through downward along the transverse processes of three or four cervical vertebræ and the whole sac laid open, which necessitated the removal of the upper fourth of the sternocleidomastoid muscle. Artificial respiration and injections of whisky were required at this stage, as respiration had ceased. When the respirations again began, search was made for the vertebral artery, which was finally taken up, at its curvature around the axis, and ligated. The bleeding stopped. The vertebral artery was nearly as large as the internal carotid. During ligation the respirations had stopped, and the patient was pulseless and seemed dead. After dressing the wounds, 8 ounces of defibrinated blood were transfused. The patient rallied rapidly, and left the hospital April 7th. Five years later he was treated by Dr. Kiernan for some dyspeptic difficulty, who found that, despite a very dissipated career, the patient had enjoyed good health.

The case is the first in which vertebral artery ligation has been successfully performed between the occiput and axis, and the fifth in which vertebral artery ligation for a wound involving a traumatic aneurism of the vertebral artery has resulted in recovery.

REMARKS ON DERMOID CYSTS OF THE OVARY, WITH ILLUSTRATIONS FROM SPECIMENS *

IN entering upon the question of the dermoid cysts of the ovary, I wish to call attention to the two theories of their origin. According to Heschl, dermoid cysts in general owe their origin to isolated islands of the epiblast, displaced during embryonal development and located somewhere in the territory of the mesoblast. This theory of fetal inclusion did not explain the origin of the dermoid cysts in the testicle and ovaries. It was not until His had shown that the internal genital organs are developed from a part of the embryo, the so-called "Axenstrang," in which all the germinal layers are included, that we were able to understand the presence of dermoid cysts in those genital glands.

The second theory of the origin of dermoid cysts in the ovary is the view of the older authors, recently adopted by Waldeyer. Epithelial cells of the ovary, capable of transformation into the ovum with all its formative possibilities, may enter into an irregular formative activity and produce a dermoid cyst—a process almost analogous to a parthenogenetic development, as Olshausen states it. This second theory would only explain the origin of dermoid cysts in the ovary, and would not enable us to understand their presence in all other parts of the body. Consequently, it seems more natural to accept the Heschl-His theory, as this gives a satisfactory explanation of the origin of dermoid cysts in general, and is in conformity with Cohnheim's theory of the origin of all other new formations, from an isolated group of embryonal cells, dormant until the unknown cause of the new formation calls them into formative activity.

A dermoid cyst is always a monocyst, and if, as is seldom the case, we find more than one in the same ovary (Olshausen in one case found three), we may expect to have had more than one embryonal matrix, from each of which a cyst has developed, the one independent of the other. It often appears as if a dermoid cyst of the ovary were a multiple one, but closer examination will prove that we have before us a combination of a dermoid cyst and a proliferating cystoma, or, more rarely, a dermoid cyst with multiple local colloid degeneration of the stroma of the wall. Cystic transformation of the sweat-glands—extensive cysts to the size of a fist—was seen in one case by Friedländer.

I shall not go any further into the subject of the dermoid cysts here, but only present to the Society 3 specimens removed by laparotomy

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* Chicago Med. Jour. and Examiner, 1887, vol. liv, p. 381.

within the past year, and will call attention to the points of interest illustrated by each one in particular.

Case I.—This specimen, at the time of the operation the size of a fist, now much smaller from shrinking in the alcohol, was removed from a girl of twenty. There was no difficulty about the removal, but I am sorry to say that the patient died from acute sepsis thirty-six hours after the operation. Besides the sebaceous matter and the hairs, which you have already seen in Dr. Jackson's specimens, we find in dermoid cysts very commonly —in from 20 to 50 per cent. of the cases—teeth inserted in the soft dermoid wall or in pieces of bone contained in the latter, or, finally, free in the contents of the sac. As a rule, there are only a few teeth in a cyst; but Schnabel has seen, in a case of a girl of thirteen, over 100, and Autenrieth describes a case in a twenty-two-year-old woman in which 300 teeth were removed and as many more left in the cyst. As Olshausen states, it is impossible to understand the presence of such numbers of teeth without the explanation that, the same as in children, multiplication of the enamel germ takes place, and a set of milk-teeth are followed by a set of permanent ones. That this is more than a mere theory is proved by a specimen in Rokitansky's collection in Vienna, in which there is seen a milk-tooth with the root absorbed down to the crown by atrophy from pressure of the overlying permanent tooth. Spencer Wells, in his "Ovarian Tumors," states that he has seen one similar instance. In the specimen before us this fact is illustrated to perfection. From the soft parts on the surface of this little piece of bone, in the wall of the cyst, you see attached a tooth corresponding in shape and size exactly to a temporary incisor of the upper jaw. I have made an incision through the gum, if we may use that expression, and, as you see, the root is absorbed almost down to the crown. When we turn this milk-tooth to the side, we see the crown of the overlying tooth. This is larger, and has the exact shape of the corresponding permanent incisor.

Case II.—The next specimen is a very large dermoid cyst from the left ovary of a woman at fifty. It filled the whole abdominal cavity up into the cardia, and gave the exact symptoms of a proliferating cystoma or multiple cyst, as there were felt, besides the main cavity, harder, lobulated portions, which I supposed to be smaller and more tense cysts. As she gave the history of a cyst which ruptured when she was fourteen years old and caused several months of suffering from peritoneal symptoms and then disappeared, not to return until after the age of forty-five, I thought that a dermoid cyst was out of the question. At the operation, which was difficult on account of many adhesions and the nature of the contents of the cyst, I found this very large dermoid cyst, containing—

(*a*) Three or four gallons of a brownish fluid, in which floated hundreds of thousands of round, yellowish-white, small bodies, the size of a hemp-seed up to a pea. I pass around a sample of them in these two glasses. These bodies are soft, have the consistence of butter, and are found under the microscope to consist of irregular masses of amorphous fat, with pavement epithelial cells interspersed here and there, single or in groups.

(*b*) A yellowish-white, butter-like mass, the same as the small bodies if matted together, filling up entirely some of the chambers of the cyst, with no fluid mixed with it. This peculiar arrangement of the fat is rare. Rokitansky saw in a cyst 70 bodies the size of a hazelnut and very many the size of a pea swimming in a brownish fluid. Routh, according to Spencer Wells, saw a similar case, the balls showing under the microscope concentric layers of amorphous fat around a nucleus of cholesterin crystals. Fränkel, cited by Olshausen, found the whole contents of a dermoid cyst to be numerous hard, mostly round or irregular balls, consisting of amorphous fat, fatty degenerated epithelial cells, and hairs. The shape of the cyst is peculiar, inasmuch as it gives the appearance of a conglomeration of cysts. But close inspection shows that all these communicate with each other so as to form one large though very irregular cavity. Thus in reality we have before us a monocyst, characteristic of the dermoids, as I mentioned before. In the wall, however, we find a number of smaller cysts, the size of a pea to a hazelnut—these do not contain the same fatty material as the main cyst, but a colloid mass, and are due to secondary colloid degeneration in the wall of the latter. The inner surface of the large dermoid cyst shows in some places irregular masses of bone embedded in the wall, and, further, as in Dr. Jackson's cases, the following condition: We do not find typical skin, with hairs, sebaceous glands, epidermis, and so on, everywhere on the inside. This is found only on part of it, forming one or several irregular islands. The remainder of the cyst-wall is smooth, has the characteristics of an ordinary cystoma, with a single layer of epithelial, cuboid, or cylindric cells. It may be that the dermoid portion of the wall secretes the fat and the cystoid portion mainly a serous or albuminous fluid. Movements of a cyst containing at the same time a thin serous fluid and sebaceous matter might (Rokitansky) shape this suspended fat into the small, round masses just the same as butter when in the process of churning. However, if this was the right explanation, it appears that this peculiar formation is seen only in very exceptional cases. The right ovary was transformed into a dermoid cyst the size of an orange. Notwithstanding the dermoid cysts on both sides, the woman had a number of children, the youngest sixteen years old at the time of the operation. The patient never rallied from the shock of the operation, and died twelve hours afterward.

Case III.—The third specimen is a dermoid cyst taken from a woman of twenty-three. It was noticed for about one year and a half before the operation, at which time it was one and a half times as large as a child's head. There was no particular difficulty about getting it out. When I opened the abdomen and came on the cyst, it was transparent, so that I did not think it was a dermoid cyst, and I inserted a Kôberle's trocar, which, of course, we should never do in dermoid cysts if we can help it. Immediately the trocar was stopped up by what I found later was a mass of hairs and sebaceous matter, so that I had some difficulty in keeping the abdominal cavity clean. However, she recovered without any greater trouble than a little abscess in the abdominal wall from one of the sutures.

Before demonstrating the specimen I wish to make a few remarks in regard to malignancy of dermoid cysts. As a rule, we regard a dermoid cyst as a benignant new formation, and a malignant character is here a rather rare exception. We make a distinction between malignancy of a dermoid cyst *per se* and malignancy from a combination of dermoid cysts with carcinoma or sarcoma. The malignancy of a dermoid cyst as such is very rarely seen. Kolaczek relates a case, operated upon by Martini, in which, besides a common dermoid cyst with a perfectly smooth surface, there were found in the walls of the peritoneal cavity small nodules in great number, the size of a millet-seed, and a yellowish color. Many of these little tumors had a light-colored hair sticking out from their centers into the peritoneal cavity. Similar were seen in a case operated upon by Billroth, reported by Fränkel.

Malignancy of a dermoid cyst from combination with carcinoma, sarcoma, and myoma: These tumors, originating in the tissues of the cyst, are not so very seldom met with, and have been observed more commonly of late years because a more minute microscopic examination is made now than in former years. Olshausen mentions, as bearing upon this subject, a statement of Doran that he had seen in several instances malignant tumors of the abdominal cavity follow extirpation of dermoid cysts. On examining the main wall of the specimen before us, we find on the dermoid island, with its hairs and a plate of bone in the wall, the following unusual formations:

(*a*) A large black mole: It is of irregular, lobulated shape, 2 by 3 inches in diameter, slightly elevated over the surrounding skin, and has a velvety, uneven surface, without hairs. Microscopic examination shows the common structure of pigmented moles, which, as you will remember, has a great similarity to that of a sarcoma.

(*b*) A papilloma the size of a pea: You will see it outside of the mole, on the skin over the bony mass. It is surrounded by a thick, wrinkled skin beset with hairs. On transverse section it shows a solid center covered with the pointed excrescences resembling exactly a large wart with long papillæ, as we sometimes find them on the skin of the hand. A detailed microscopic examination and description of all the specimens is not as yet finished, but I intend to give it in a future discussion. It is sufficient, however, here to call attention to the important bearing the two benignant new formations found in this cyst have upon the malignancy just spoken of. It is well known that moles often furnish the soil for sarcomata, and that warts or papillomata, for years benignant, sometimes all of a sudden commence to grow because they are transformed into a carcinoma or a sarcoma. The rapidity with which a dermoid cyst sometimes will grow involves a great nutritive hyperactivity. I can understand that this, in its turbulent way of forming tissues without an etiologic object, could cause the physiologic resistance to disappear and thus open up the gates for malignant tumors.

THE OPERATIVE TREATMENT OF RETROPERITONEAL CYSTS IN CONNECTION WITH MIKULICZ'S METHOD OF DRAINAGE*

It is not my intention to give an exhaustive review of the entire subject of retroperitoneal or parovarian cysts, but I merely wish to call attention to the subject for discussion, giving some of my own experiences, with a view to bringing out those of other Fellows of the Society. The subject is that of so-called parovarian cysts, or cysts of the broad ligament, or cysts with fimbriated epithelium, and I wish to call attention to a few facts concerning them before showing specimens.

We know that these cysts are said, in a great majority of cases, to develop from the parovarium, the rudimentary sexual remnant of the Wolffian bodies; more rarely they are said to develop from the epoophoron; finally, it is possible that cysts of the broad ligament may originate from hematomas. The canals of the parovarium, being lined with fimbriated epithelium, may account for the fact that the inside of a number of these cysts is found to be lined with this form of epithelium.

Parovarian cysts are typical monocysts. In this respect they differ materially from proliferating cystomata or other ovarian cysts developed in or into the broad ligament. Both classes are retroperitoneal cysts, inasmuch as they are situated behind the peritoneum of the posterior wall of the abdomen, but the cysts of ovarian origin are more likely to have only a partial retroperitoneal or intraligamentous development; that is, part of the tumor within, part outside of, the broad ligament; while the parovarian cysts proper are more likely to be completely surrounded by the broad ligament. From the broad ligament, and separating its two layers, they commonly develop inward to the sides of the uterus and downward toward the bottom of the small pelvis.

They are usually thin-walled, lined with fimbriated epithelium or mixed fimbriated and common cylindric epithelium; consequently their interior surface is smooth, and they contain a thin, colorless, clear fluid of low specific gravity, with no formed elements. Between the peritoneal covering and the cyst-wall there is usually a layer of loose connective tissue with but few vessels, which explains the facility with which these cysts may sometimes be separated from the broad ligament covering them, and enucleated without the use of cutting instruments, and with very little harm.

A typical cyst of this kind should have the Fallopian tube on its outside stretched out and flattened, because the cyst develops into the little mesentery of the tube. In the same way the ovary is found stretched out and flattened on the outside of the cyst near the tube. Exceptions to these common anatomic characters, however, are found. The cyst-wall may be thick, may become the seat of secondary growths, such as papillæ or papillomatous fimbriated tumors, which, having developed on the inside of the cyst, may perforate the cyst-wall, protrude on the outside, and take upon them a malignant or semi-malignant character, invade the general peritoneal cavity, giving rise to multiple metastatic papillomata.

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* Jour. Amer. Med. Assoc. 1887, vol. viii, p. 568. Remarks before the Chicago Gynecological Society, March 18, 1887.

In cases of this kind the contents of the cyst is not a thin, clear, serous fluid, but resembles more or less the fluid of the ovarian cystomata, with numerous formed elements, viscid character, and hematin or blood mixed with it. The connective-tissue layer between the cyst and the broad ligament may not be loose and deficient in vessels, but is sometimes so tense as to make separation of the cyst here almost or entirely impossible, and it may contain numerous large vessels.

As to the symptoms: The cysts usually grow slowly, and do not cause any inconvenience unless they reach a considerable size. They are usually not very tense. The fluctuation is quite distinct and superficial. When such a monocyst is large, the abdomen is likely to be flat when the patient is recumbent, as in ascites, and the percussion-note is apt to change somewhat with the position of the patient, thereby sometimes making the differential diagnosis still more difficult.

The parovarian cysts are likely to burst spontaneously, but the contained fluid is so little irritative in character that peritonitic symptoms rarely follow, the thin, clear fluid being absorbed quickly and readily. On this account these are the cysts of the abdominal cavity which best permit of puncture or aspiration, as these trifling operations are not uncommonly followed by radical cures.

In this connection I will describe a case which came under my observation in 1884. A girl eighteen years of age came to me from Racine, who had a cyst extending above the umbilicus, and about the size of a uterus in the seventh month of gestation. She had been accused by her relatives of being pregnant, but knowing this was not the case, came on here. On examination I found the uterus of normal size on one side of the cyst, and in my office, with a common hypodermic syringe, I drew off and took away for examination a perfectly clear fluid, and told the patient to come down for operation. She went home to make her arrangements, and came down a month later. The cyst had entirely disappeared, without symptoms of peritonitis.

In a case like this there may, of course, be a doubt as to the correctness of the diagnosis of a parovarian cyst; but it is reasonably certain that this was the case, as one of the characteristics of this class of cysts is that rupture into the peritoneal cavity causes no peritonitis, and the fluid is absorbed without difficulty.

The method of operating on these cysts we owe to Dr. Miner, of Buffalo, N. Y., who published in 1869 his operation by enucleation.

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In some cases of parovarian cysts the development is to such an extent peripheral in the broad ligament that the uterine half of the latter is long enough for the formation of a pedicle. In such cases the usual operation for ovarian cysts may be performed at a sacrifice of the covering broad ligament, with tube and ovary. But such a peripheral development is not the rule, and whenever the cyst is developed down upon the uterus or into Douglas' fossa, or farther away still in the retroperitoneal space, enucleation is the only method available for its complete removal.

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About a year ago Mikulicz, of Cracow, proposed the following method of drainage, not only for retroperitoneal cysts, which can be excluded from the general peritoneal cavity, by uniting them to the abdominal wound, but also for drainage in the peritoneal cavity itself. He takes a small piece of iodoform gauze, stitches a silk thread to the center of it, and folds it up in the form of a pouch, the silk thread being

inside, that the pouch may be drawn up from the bottom by it. The pouch is now pushed down to the bottom of the cavity, and if nooks and corners exist, it is pushed out so as completely to fill them. In the inside the pouch is packed with iodoform gauze, as much as is necessary completely to fill up these spaces. This is the advantage claimed by Mikulicz for this method of drainage as compared with the use of glass or rubber drainage. Besides the disinfectant properties of the iodoform gauze applied to the entire wall of such a cyst, Mikulicz states, as one of the advantages of his method, that, by the capillary attraction of the gauze, everything is brought out—fluids which a glass or rubber drain could not bring out. We must remember that when we drain the peritoneal cavity with a glass drain down between the intestines or in the cavity of the cyst, we cannot always expect to get surrounding organs in so close contact with the drain as to drive the fluid out.

Further, there is this to consider: that a glass drain put down in the free peritoneal cavity has no tendency to bring out the fluid accumulated at the bottom; the intestines, filled with air, will simply swim in the fluid, and there is no pressure from without that will bring this fluid out of the glass drain, while the capillarity of the gauze is likely to help in that direction. I have had this remain in all these cases for about two weeks. As soon as the discharge ceases I commence first to pull out the loose gauze inside the sac. If a space is left after this has been pulled out, I press in at that dressing a little more gauze. This is gradually removed, and the pouch itself is then pulled out by the thread gradually and finally. In all my cases it came out at about the end of the second week.

The second case was similar to the first, inasmuch as there was no possibility, at least as far as my ability went, of getting the cyst out. It was a large cyst of eight years' development in a woman fifty years of age from Sioux City, Iowa. A prolapse of the uterus had developed during this time, and I was able to get out of the cyst, after considerable dissection, hardly more than two square inches. I used the Mikulicz drain, with the same result as before. The patient was operated upon October 31, 1886.

In the two above-mentioned cases enucleation was impossible, and we, with Ohlshausen, may have to class them under unfinished operations, so far as the extirpation of the cyst is concerned. But in cysts of the broad ligament, such an unfinished operation is, as a rule, followed by undisturbed and perfect recovery, and so I feel inclined rather to classify the above-named method of operating as a legitimate one for non-enucleable parovarian cysts, than to use the somewhat misleading and sinister term of incomplete operation.

The third case was a woman fifty years of age, in whom the cyst had taken three years to develop. The operation was performed February 2, 1887. The outside of the cyst looked smooth in this case because the connective tissue was so loose. It was the easiest thing imaginable to enucleate it from the retroperitoneal cavity in which it was developed.

There were not two vessels to tie, and this accounts for the smoothness of the outer surface. This cyst was a typically normal one of that class, as it was covered all over with the broad ligament. The fluid was perfectly clear; no remnant of blood-clot was present.

Now, when the cyst has been enucleated, the question arises, what to do. I was afraid to leave this large retroperitoneal wound without drainage, so I used Mikulicz's method, and the woman is well. It is, however, a debatable question, and in the future it is probable that in a case like this drainage will not be used. Authorities like Olshausen very strongly recommend, even for a cavity as large as that, not to drain at all—not even to unite the surface of the peritoneum so as to exclude the retroperitoneal wound from the general peritoneal cavity. He says that when there is no infection, no sepsis, during the operation, there will be no peritonitis, and no septicemia afterward. He also states that he usually leaves the cavity alone after these enucleations, and that peritonitis seldom or never follows as a consequence of the operation, nor do pelvic abrasions form.

This is where the matter stands, and these are the points for discussion. I must say that I do not dare to rely so fully on entire asepsis during the operation as to leave drainage out. Undoubtedly the recovery of the patient is quicker and easier without than with drainage, as very often, in the latter case, a fistula remains which may keep open for months.

The fourth case was an old and rather anemic patient, more than fifty years of age, but apparently sixty. She was pale and emaciated, and had a large retroperitoneal cyst, located partly in the peritoneal and partly in the retroperitoneal cavity, or, in other words, of partly extraligamentous and partly intraligamentous development. As a natural consequence, the enucleation was difficult, since the peritoneal cavity was once entered. On the inside of the cyst were papillomatous masses such as are found in smaller growths—cystomata of the ovary. These, of course, always indicate malignancy. On the inside of this cyst the surface was rough, velvety from the diffuse papillomatous condition of the entire inner wall, and in some places grown out into a large papilloma, but in no place smooth.

The operation in this case was rendered more difficult because the connective tissue surrounding the intraligamentous portion of the cyst was comparatively tense, and, further, because it had grown up into the mesentery of the sigmoid flexure, so as to be covered by it. When the cyst was enucleated, there was a portion of the sigmoid flexure that I was afraid of.

There is one other point beside the intestines which we should be careful to avoid in the extirpation of these retroperitoneal cysts; that is, the ureters. As soon as we get into the neighborhood of the large vessels in the posterior wall, we must look carefully out for the ureters and locate them by palpation, as when the ureter is adherent to the cyst, it may be easily torn. Mikulicz's drainage was used in this case, as in the others. The first three or four days she had no untoward symptoms, but on the fourth or fifth day she commenced to vomit, and became somewhat delirious and sleepy, and died, the temperature not having exceeded 101° or 102° F. I saw her the evening before she died, and expected, on account of the vomiting, to find peritonitis, but there were no local symptoms at all. Then I supposed it to be sepsis without peritonitis, but the autopsy showed the cause of death to be uremia.

We found in both kidneys, from pressure of the tumor on the ureters in a state of dilatation, not exactly hydronephrosis, but dilatation and subsequent atrophy, to a sufficient degree in my opinion to account for uremia, for we know that patients with so much degenerative disease of the kidneys of any kind as almost to reach the limit of secreting tissue are apt to get uremia after operation. Whether the operation or the anesthetic is the cause, I cannot say; but it is a well-known fact. After the opening of the abdominal cavity Mikulicz's drain was laid down right between the loops of intestine, and, of course, a local but aseptic peritonitis formed along the drain. You will notice on the specimen I now present the impression of the meshes of the tissue of the drain, but outside of this a perfectly clear and smooth peritoneum.

As I remarked before, the chief point for discussion is the drainage. Olshausen does not drain in any such cases. This may be thus explained: He says that in many cases of this kind it is impossible to finish the operation. If we accept his classification, two of my cases would be termed unfinished operations; but I am certain that with an unfinished operation and a Mikulicz's drain, a radical cure may be effected just as well, perhaps, as if the cyst had been taken out.

VAGINAL HYSTERECTOMY *

THE ACTUAL STATUS OF THE OPERATION AND REPORT OF 4 CASES

IN the short space of eight years, since 1879, when Czerny, Billroth, Schröder, and Mikulicz revived vaginal hysterectomy, a large number of operations—probably nearly 500—have been performed, and a considerable amount of literature on this subject has been brought forth. In spite of adverse criticism and the apparent gravity of the operation, it has had a more thorough and general trial than could have been expected in so short a time, and for an operation attended by the uncertainty as to results which pertains to all operations for malignant tumors.

Modern surgery, with its allowance of more radical and wider lines for the operations for the removal of sarcomata and carcinomata, has generally procured a larger percentage of definite cures for these tumors in all parts of the body. Although a percentage of between 10 and 20 permanent cures seems small, yet it holds out a distinct ray of hope as compared with inevitable death on the side of non-interference—a ray strong enough to cause operations of this kind to be kept up, even if the immediate risk to life is considerable. This immediate mortality, however, must be within certain limits to permit of the general adoption of an operation. Freund's abdominal hysterectomy, with its mortality of 70 per cent., was too grave even for malignant tumors. Vaginal hysterectomy, with an initial mortality of about 30 per cent., was not so grave as to prevent the general adoption of the operation. But even this mortality has been one of the main arguments advanced from the beginning against the practicability of the operation. It is, therefore, an important question to ask: Has vaginal hysterectomy become less dangerous since its revival by Czerny in 1879?

The mortality from the operation for the first five years, up to 1884, has been stated by Mundé to be 28 per cent. In a paper read before the American Gynecological Association in 1884 he tabulated all the cases to be found in the literature, both in Europe and in the United States. The number of operations was 255, with 72 deaths. For the operations of 1885, recorded in Virchow's Jahresbericht for 1886, the mortality is already much lower. I find reports from 32 operators of 106 cases, with 17 deaths, or 16 per cent. R. Martin reports, in his work of 1887, 66 cases with 11 deaths, or 16 per cent. Special reports from

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* Medical Journal and Examiner, 1887, vol. lv, p. 367.

individual operators in the past year show even more favorable results. Thus we find reported by Klotz 17 cases, with no deaths, and by T. Gaillard Thomas, 15 cases, with no deaths. Most valuable, however, from the large number of cases, are the recent reports of Fritsch and Leopold. Fritsch reports 60 cases, with 7 deaths, or 11⅔ per cent., and Leopold, 48 cases, with 3 deaths, or 6.25 per cent. The reports from the last operators include all their operations from 1883 to 1887. Leopold's mortality of 6.25 per cent. is the lowest on record for a large number of cases.

In the beginning of his work in this line every operator has undoubtedly operated in cases which were too far advanced for reasonable hope of eradication of the disease. The more recent the origin of the tumor, and, consequently, the more limited the extent of the growth, the better are the immediate, as well as the remote, prospects for the patient. If, then, in future, the cases for operation are properly selected, we may expect that the mortality will reach a reasonably low figure. I think we must agree with Fritsch in his statement that he has "no doubt that in the near future the mortality in general will come down to 3 or 4 per cent."

It certainly seems remarkable and far surpassing all expectations that, in less than ten years after the reintroduction of this operation in surgery, its mortality should have come down to almost the same point as that from laparotomy for ovarian tumors. Ovariotomy required a much longer series of years to attain the point of safety which it has now gained. Vaginal hysterectomy for carcinoma may now be said to be not more dangerous than the extirpation of a carcinomatous mamma, with removal of the axillary glands, for which operation Billroth in 1880 gave a mortality of 10 per cent.—a percentage still further reduced, as shown by Schmidt, from Küster's service in the Augusta Hospital in Berlin, to 5.2 per cent.

The partial operation of low or high vaginal amputation of the cervix has been urged as a substitute for vaginal hysterectomy in all cases of carcinoma of the vaginal portion, and the more limited cases of carcinoma of the cervix. The former operation is said to be much less dangerous than the latter. We must then ask the question: Are partial operations on the carcinomatous uterus, provided they permit of the effective removal of the tumor, preferable, as being much less dangerous than the operation of total extirpation?

Pawlik reports a large series of galvanocaustic operations from Braun's clinic in Vienna—137 cases, with 10 deaths; that is, 7⅓ per cent. In 12 of the cases of recovery late hemorrhages of a severe character were observed. Schröder reports 136 amputations of the vaginal portion and cervix, with 10 deaths from sepsis—that is, 7.4 per cent. Wallace reports 10 cases with 2 deaths, or 20 per cent. Gusserow has had 33 cases, with 3 deaths, or 9 per cent.

We may thus conclude that if the mortality of total hysterectomy is in the neighborhood of 10 per cent., the operation is not much more dangerous than the partial vaginal operation, and agree with Schatz, who wrote in 1883: "The danger of the high vaginal amputation does not seem to be much smaller than that of the total extirpation."

A much larger field than hitherto will undoubtedly be accorded in future to vaginal hysterectomy. It is in many cases almost impossible to determine, during the operation, how far up into the wall of the uterus the carcinomatous tissue extends. Even with a mortality of 25 per cent. from total extirpation Gusserow, in doubtful cases, prefers this to the partial operations. In this connection he states: "The safer the total extirpation becomes, the more will it take the place of amputation of the cervix."

The experience in a very complicated case of Binswanger is of importance in our choice of operation. He found a perfectly isolated portio carcinoma, accompanied by an also isolated carcinomatous degeneration of the mucous membrane of the fundus. It is generally accepted as a law in surgery of the mammary gland that, however localized a small carcinomatous nodule may be, nothing less than the removal of the entire gland—and, I think it safe to add, the lymphatics of the axilla—would be the safe operative procedure to adopt. It can thus be understood that authors, as Sänger, Leopold, Fritsch, who believe in a low mortality for vaginal hysterectomy, require this operation to be done in all cases of limited carcinomata, even small carcinomata of the vaginal portion, to the exclusion of any of the partial operations. Fritsch calls attention to the fact that a strict line of demarcation between carcinoma of the cervix and of the vaginal portion, as described by Ruge and Veit, in their classic article on "Uterine Carcinomata," does not exist in all cases. Some apparent portio carcinomata extend deeply up into the cervix. It is often impossible, during a partial operation, to determine whether we operate in healthy tissue or not; consequently, in the majority of such cases, total extirpation is safer as a radical cure of the carcinoma than partial operation.

Indications.—It is important to determine in a given case whether a carcinoma can be operated upon with success, or if it should be let alone. Cancerous invasion of any of the tissues surrounding the uterus is a contraindication for an operation. Especially important is the mobility of the organ. Impaired mobility usually means invasion of the broad ligaments, and to this class belong most of the cases in which the operation has had either to be abandoned or has been exceedingly difficult and dangerous, and been followed by speedy relapse *in loco*. If the uterus is not fairly movable, the technical difficulties of the extirpation are well-nigh insurmountable. At the same time we must be aware of the possibility of meeting with commencing carcinoma in a uterus immobilized by independent parametritic exudates. If in such a case we are able to make a diagnosis, there is the possibility of enucleating the uterus from the connective-tissue masses in which it is embedded without opening the peritoneal cavity—the so-called extraperitoneal vaginal hysterectomy. This operation was performed years ago by Czerny, and it has been lately recommended by Frank. As the cases up to this time are so few, and the descriptions of them so incomplete, further experience is needed.

Recently, vaginal hysterectomy has been resorted to in diseases of the uterus other than malignant tumors. Besides a not inconsiderable number of operations for prolapse of the uterus, Leopold has made the extirpation for severe neurosis; Bernays, Frank, and others for retroflexion, and Frank in several cases of chronic granulating adenomatous endometritis, when complicated by hemorrhage or parametritis. As yet, the last named as indications for the operation do not seem to be generally accepted.

The operation itself, as far as the details of the procedure are concerned, is remarkably unsettled, and it is difficult to find two surgeons who operate exactly in the same manner. The principal object to be attained in the choice of operation is security against hemorrhage and sepsis of the abdominal cavity, as well as of the vaginal wound. The more recent changes in the operation in this direction have undoubtedly contributed to lessen its immediate mortality.

The same preparatory measures are generally adopted as for laparotomy, with a view to having the alimentary canal empty. Thorough disinfection of the vagina is, in the case of an ulcerating carcinoma, rather difficult, and opinions are divided whether the removal of the fetid carcinoma tissue with the sharp spoon should take place a day or two before the operation (Hegar), or whether it can be postponed so as to be the first step in the operation (Leopold and Fritsch). It seems most convenient to do all the operating at once, when, as has been demonstrated by the two last-named operators, sufficient immediate disinfection can be had during the operation.

The lithotomy position is the one almost exclusively chosen as the most convenient. Only a few, such as A. P. Dudley, of New York, prefer to operate in Sims' position. Mundé tried this position, but gave it up as inconvenient. It would seem that blood and irrigation fluid would be more likely to enter the abdominal cavity in Sims' position, on account of the difference in pressure in the vagina and abdominal cavity characteristic of the latter position.

It will be necessary to divide a narrow vagina posteriorly, to make room for the operation. Simon's specula, or retractors of different sizes, or Fritsch's speculum, with an apparatus for constant irrigation, may be used.

It does not matter whether the uterus is drawn down into the vulva with a strong loop of silk or the forceps, provided the cervical tissue has consistence enough to give a good hold. Mikulicz's loop of silk through the lower part of the parametria does not help materially in bringing the uterus down, although it may assist in making the division of the lateral attachments bloodless. Fritsch lays great stress on commencing the operation by detaching the parametria from the sides of the cervix, which he accomplishes in the following manner: He divides the parametria after successive ligatures *en masse* of portions of the tissue, each one deeper than the preceding one, until, after three to five such ligatures, the lower border of the lateral ligament is reached. Hemorrhage from the uterine artery or its branches is thus prevented almost entirely, and the uterus becomes loose, and can very easily be brought down into the vulva so as to give greater facility to the succeeding steps in the operation.

In the detachment of the bladder and rectum from the cervix Martin and Hegar try to avoid hemorrhage from the vaginoperitoneal wound surface by a row of sutures, including successively one portion after another of the tissues to be divided. This procedure takes a good deal of time, some of which may, however, be saved by not having to ligate bleeding points after the division, hemorrhage from which, although not copious, may sometimes prove very troublesome.

The opening of the peritoneal cavity, before and behind the uterus, should always be preceded by a renewed, thorough disinfection of the entire field of operation. Right here arises the question of keeping septic material out of the peritoneal cavity. If all hemorrhage is stopped by the above-mentioned precautions, sepsis could only arise from contact between the peritoneum and the carcinomatous cervix and uterine canal. Fritsch recommends that the posterior fornix be left in connection with the uterus until the very last—that is, until after the detachment of the bladder and the ligation of the broad ligaments. A disinfected sponge is passed up between the uterus and the bladder, and placed above and behind the fundus. To the sponge should be attached a loop of silk or silver wire (Leopold), as difficulty has sometimes been experienced in finding and removing a loose sponge from the pelvis. Fritsch draws down the fundus of the uterus through the anterior culdesac while he ligates the broad ligaments, thus leaving the carcinomatous cervix in the posterior fornix, which has not yet been opened, and avoids contact with the peritoneum by making the division of the posterior fornix the last step in the detachment of the uterus.

Leopold opens into Douglas' fossa before ligating the broad ligaments, but he never turns—that is, anteverts or retroverts the uterus. During the ligation of the ligaments the uterus is left in place, so that the carcinomatous cervix remains down in the vagina during the entire operation.

I have some doubt whether it is convenient or even possible in all cases to keep the uterus *in situ* during the ligation of the broad ligament. In my first case, in which the fundus was small, it was natural and easy. In the second case, in which the uterus was larger, I found it easier to antevert. Thus, Fritsch's advice in this direction appears more applicable to cases in general.

Ligation of the broad ligaments is one of the most important steps in hysterectomy, inasmuch as the large vessels, uterine and spermatic, must be ligated with entire safety so as to avoid fatal hemorrhage. Fear of not thus securing the vessels from bleeding has brought forth a great variety of methods to attain this end.

The use of the galvanocautery and thermocautery to insure security against hemorrhage from the broad ligaments has been occasionally tried by Anderson and Simpson, and speedily abandoned as unsafe; Simpson's patient died from secondary hemorrhage.

Ligation en masse has been used by Billroth, Wölfler, Mikulicz, Schröder, and Thiersch. The dangers of ligation *en masse*, from its liability to slip, compelled Billroth to compress the ligament with strong forceps before applying the ligature. Schröder added several separate ligatures. Olshausen used a Cintrat's wire constrictor, and, later, elastic ligature.

Ligation in Portions.—Czerny had already ligated in three portions, and many operators followed this method.

Hemostatic forceps left in place for twenty-four to thirty-six hours (Péan).

Partial ligation, step by step, is probably the safest, and now the most commonly adopted, method. It is hardly necessary, as Hofmeier proposed, to divide the ligament between successive double ligatures, as there is very little hemorrhage from the uterine ends of the vessels. Thus the single step ligatures, as proposed by Sänger, and now used by Martin, von Teuffel, Fritsch, Leopold, and many others, is at present regarded as the safest method of procedure.

The treatment of the peritoneal and vaginal wound is of paramount importance, inasmuch as thereupon depends the prevention of septic inflammation in the peritoneal cavity, as well as in the tissues within the pelvis. Great diversity of opinion still prevails as to the best method to be adopted.

Schatz procures drainage by keeping the patient in a sitting position during the after-treatment—a method altogether inconvenient for the patient.

Schröder has left both wounds open; united the broad ligament with the lateral corner of the vaginal wound, and placed a T-shaped drainage-tube in Douglas' fossa.

Olshausen uses a drain in Douglas' fossa and iodoform gauze in the vagina.

Martin uses a T-shaped drain in Douglas' fossa. Bottini, Simpson, Thiersch, Leopold, and Fritsch use iodoform gauze drain from Douglas' fossa down into the vagina.

The peritoneal wound has been partially united, and an opening into the peritoneal cavity left for drainage, either in the center or at each corner of the wound (Czerny). The peritoneal wound has been left open, and the vaginal wound partly united (Sänger); iodoform gauze in the vagina, the peritoneal wound united, and the vaginal wound left open (Billroth, Wölfler, Mikulicz, Kaltenbach, von Teuffel.

The peritoneal wound has been united and the vaginal wound partly closed (Tauffer). Regarding this, Tauffer makes the following remarks: "I am convinced the total or partial leaving open of the vaginoperitoneal wound represents a stage in the development of vaginal hysterectomy which will soon be passed by, and that the total closure of the wound by suture will be generally adopted."

In most cases of vaginal hysterectomy no wound surfaces are left in the peritoneal cavity, and consequently there seems to be nothing to drain. When the ligatures in the broad ligaments are brought out into the vagina and kept there by sutures, there seems to be less reason to drain after vaginal hysterectomy than after uncomplicated cases of ovariotomy or oöphorectomy. In one of my cases (Case I) total closure of the wound was followed by a perfectly aseptic course of after-treatment.

Shall the ovaries and tubes be removed, or can they be left? In the majority of vaginal hysterectomies as yet on record the ovaries and tubes have been left, and yet complaints of sufferings from periodic disturbances in these organs are of very rare occurrence. Schröder and Tauffer report one case each in which pain afterward might be referred to the ovary. Schröder's patient had pain at the time of her menstrual period, but there was never any hemorrhage. Tauffer's patient had pain in an ovary, supposed to be included in the cicatrix.

Fritsch advises that the ovaries and the tubes be removed when the patient is young, and the organs can be brought down in the wound with reasonable ease. Leopold gives similar advice. Brennecke is of the opinion that the ovaries and tubes can always be left without any disadvantage to the patient. The ovaries left in seem in a short time to become atrophic and cease to have any physiologic activity. He saw, quite commonly, especially in younger patients, more or less vague menstrual molimina in the first two to six months after the operation, but after that time they disappeared entirely. There would thus seem to be no reason to complicate hysterectomy, which in itself is a sufficiently long operation, by removal of the uterine appendages, except in cases where these are found to be diseased.

The mishaps of the operation seem to become more and more rare, because the advanced cases are not operated upon, and because the requirement that the uterus shall be freely movable is more strictly adhered to. Thus the difficulties in separating the uterus from its surroundings are the more easily overcome.

Opening into the bladder still not infrequently occurs, even in the hands of the most skilful operators (Czerny, Olshausen, Fritsch, Martin, Hofmeier, and others). The opening, however, has usually no more serious consequences than the existence of a temporary vesicovaginal fistula, which generally closes spontaneously in a few weeks.

Injury to the Ureter.—It was a common occurrence in the abdominal hysterectomy of Freund that one or both ureters were either divided or ligated. In the vaginal hysterectomy injury to the ureter is just as rare as injury to the bladder is common. Starck, in 1882, had to remove a piece of the ureter because it was involved in carcinomatous tissue. Boeckel, in 1884, had an injury to the ureter, probably from its being included in a hemostatic forceps, which, according to Péan's method of operating, was left in permanently. In both cases subsequent nephrectomy was resorted to successfully. In early operations with a movable uterus there is, in the modern method of operating, little or no danger of injuring the ureter during vaginal hysterectomy.

Permanent recovery after vaginal hysterectomy for carcinoma depends, as in all other removals of malignant tumors, partly on the anatomic characteristics of the latter and partly on early operation. The reports from the literature in this regard are imperfect, because the operation is new and the reports recent, and a number of patients have been lost sight of or their later condition has never been reported.

If we consider freedom from relapse two years after the operation as a permanent recovery,—a view that is generally adopted,—it is almost astonishing to see a percentage of permanent recovery amounting to 39.2 per cent., as published by Mundé in a select series of cases which included only cases of early operation, 82 in all, with 32 permanent recoveries. Still more favorable are the reports published by Leopold, which give more than two-thirds, or 69 per cent., of radical cures.

We are certainly not accustomed, from other fields of surgery, to expect so beneficial results from operations for malignant tumors. Is this because carcinomata of the uterus, in most cases, belong to the benignant variety, or is it that the uterus, being a comparatively well-isolated organ, gives favorable chances for operating in healthy tissue by keeping the tumor localized for a certain length of time.

Should further reports coincide with the foregoing statistics, it seems evident that vaginal hysterectomy for carcinoma gives better chances for the patient than operations for carcinoma in any other part of the body.

Case I.—Mrs. E. C. M., twenty-eight years of age, married, residing in Chicago, came to my office on June 10, 1887. Her mother died of cancer of the stomach. The patient commenced to menstruate at the age of fifteen, and was always regular until the time of her marriage, in October, 1886. After that time the menses became somewhat irregular, and shortly afterward some leukorrhea appeared. The discharge gradually increased, and, in the spring of 1887, became of a somewhat fetid odor, which caused her to apply for treatment. In January, 1887, the menstrual flow was excessive, and in February she was examined by Dr. S. D. Jacobson, of this city, who kindly informed me of the local condition of the patient. He found on the posterior side of the vaginal portion of the uterus a flat erosion, ½ inch long and ¼ inch broad, surrounded by five or six small nodules looking like ovula Nabothi. In narcosis the erosion was scraped off with the sharp spoon, and the bleeding surface cauterized with a mixture of equal parts of chlorid of zinc and alcohol. For two months it looked as if the loss of substance would heal up, but in May a small, cauliflower-like excrescence appeared upon the surface.

On examination I found the following condition: The patient is pale, but not emaciated. She seems to be in good health, except for the discharge from the vagina. Examination per vaginam shows the right half of the vaginal portion of the uterus to be the seat of a hard, nodular mass. Extirpation of the carcinoma was agreed upon, the method of operating being left undecided. If vaginal amputation of the cervix proved to be insufficient for the removal of all the diseased tissue, then total extirpation of the uterus would have to be resorted to.

On June 14th the patient entered Emergency Hospital. She was prepared for the operation in the usual way, by being kept on liquid diet for several days, by thorough disinfection of the vagina by antiseptic injections, and by shaving of the external genitals.

On June 17th I operated, in the presence of Drs. Jacobson, Hall (Sr. and Jr.), Engert, Otto, and Holmboe, in the following manner: The patient was placed in the lithotomy position, and the vagina held open by Simon's specula. The narrowness of the vagina necessitated bilateral incisions in its posterior walls. The healthy part of the vaginal portion was seized with heavy vulsellum forceps, and the uterus drawn down toward the vulva. A loop of heavy silk was passed through a fold of the lateral fornix, through the lower part of the broad ligament, an inch outside of and above the vaginal portion, and knotted, with a view to securing the uterine vessels, and as a help to the further drawing down of the uterus. A circular incision was now made ½ inch outside of the carcinoma and the vaginal portion. The parametrium or lower part of the broad ligament was divided without much hemorrhage; each bleeding vessel was secured by forceps and ligated with catgut. The uterus could now be brought down into the introitus. The carcinomatous tissue was scraped off from the ulcerated surface with a sharp spoon, leaving a cavity in the right posterior half of the cervix extending upward close to the internal os.

It was, therefore, thought advisable to remove the uterus *in toto*. Thorough disinfection of the cancerous cavity and the vagina was now made with 1 : 1000 corrosive sublimate solution. The dissection between the uterus and the bladder was very easily made with blunt instruments, and finally the peritoneum was divided in the vesico-uterine fossa. From this opening a flat aseptic sponge was passed up in the small pelvis, and a loop of heavy silk was passed through the lower part of the body of the uterus, to furnish a better hold on the latter than the vulsellum forceps could give. Dissection between the cervix and rectum was next made with blunt instruments, and the peritoneum divided. The remainder of the left broad ligament was secured by hooking the left index-finger around it, and transfixed by a double silk ligature. It was then divided between this and the uterus without turning the body of the latter down into the vagina.

All visible divided vessels were now ligated with catgut; the right broad ligament was treated as the left had been, without difficulty, and the uterus was removed. The aseptic sponge originally inserted was now replaced by a larger one, which kept the omentum and small intestines out of sight. The cut ends of the broad ligament were drawn down into the vagina, and united by sutures to the lateral wall of the cervix. As the ovaries and tubes did not come down easily into the vaginal wound, it was decided to leave them in. Sutures were now passed anteroposteriorly through the vaginal wall of the anterior cervix, the posterior flaps of the peritoneum, and finally out through the posterior vaginal wall into the vagina. Six such sutures were, for the time being, left long and secured by hemostatic forceps. Before knotting these sutures the flat sponge was removed from the pelvis, and the toilet of the pelvic abdominal cavity made by smaller sponges held by long artery forceps until they came out dry and bloodless. Finally, the pelvis was iodoformized by means of a sponge dusted over with iodoform. The wound surfaces between the vagina and peritoneum were then thoroughly cleansed with 1 : 4000 corrosive sublimate solution and iodoformized. The vaginal sutures were now knotted, thus closing hermetically at the same time the peritoneal cavity and the vaginal wound. The ends of all sutures and ligatures were cut off 1½ inches from the knot. The vagina was irrigated with 1 : 1000 corrosive sublimate solution, dusted over with iodoform, and a light pad of iodoform gauze was left in the vagina. The posterior incisions in the introitus of the vagina were united with sutures and covered with iodoform gauze dressing.

The operation lasted two hours, at the end of which time the pulse was 90 and strong. There were no signs of collapse whatever. The course of the after-treatment was perfectly aseptic. There was no rise in temperature nor pulse, and no pain. For the first few days there was a little soreness in the region of the wound. After slight vomiting from the ether the patient's appetite improved rapidly, and the first passage from the bowels, on the sixth day, was entirely painless. She sat up at the beginning of the third week, and the ligatures of the left broad ligament were loosened and removed on the twentieth day. On the right broad ligament they still remained attached to the mortified peripheral end of the ligament, which was not detached until a week later. On the patient's discharge from the hospital, July 13th, the transverse linear wound was completely closed.

CASE II.—Mrs. M. McE., aged thirty, was admitted to Emergency Hospital June 14, 1887, and came under my care. She gives the following history: Parents living; no hereditary disease in the family. She was married in 1878 and has five children. Menstruation commenced at the age of fourteen, and was at times irregular until she reached the age of twenty, when it became normal. In the spring of 1883 she had an attack of pneumonia, and was then told by her attending physician that her uterus was out of place. For this she has at times been treated ever since.

Early in 1886 she was informed by her physician that there was an ulceration at the neck of the uterus. A bad-smelling discharge commenced at about the same time. Until the beginning of 1887 she had no pain. In the summer of 1886 she became pregnant, and was delivered of a female child March 23, 1887.

She has had a cystic goiter the size of a fist for many years, which has never caused her any serious difficulty. For the last four years she has been in poor health, suffering from repeated attacks of bronchitis, and has gradually become emaciated.

Present Condition.—The patient is pale, considerably emaciated. A fluctuating tumor the size of a child's head takes up the anterior aspect of the neck from the hyoid bone to the sternum. It is tense and somewhat tender, as a result of puncture and aspiration undertaken in a hospital in the city about a week before. The tumor is apparently superficially fluctuating. The tenderness is most pronounced around the seat of the puncture. Examination of the thoracic organs shows nothing abnormal. She has some cough, especially on rising, and raises a moderate amount of mucopurulent matter.

There is a discharge from the vagina of considerable quantity and fetid odor. Digital examination shows that the vaginal portion is transformed into an irregular, hard, nodulated mass, in the center of which the finger passes into a large, irregular cavity, extending through the entire neck. The uterus is movable; the rectum and bladder do not appear to be infiltrated. There is no appreciable thickening in the broad ligaments. Pulse, 110, and rather weak; temperature is normal; there is shortness of breath after exercise.

After the usual antiseptic preparations I operated on June 30, 1887, in the presence of Drs. Jacobson, Rosa Engert, Otto, Hall (Sr. and Jr.), Guerin, Holmboe, and Simons. The vagina had to be enlarged posteriorly; the uterus was drawn down with vulsellum forceps, and the same method of procedure pursued as in the previous case. The separation of the neck of the bladder from the uterus was difficult, because the carcinoma had extended into close proximity to the wall of the bladder, some of the muscular tissue of which was removed—so much so, in fact, that a sound in the bladder was covered only by mucous membrane. The neck was amputated at the internal os, because in this instance it proved more convenient to evert the body of the uterus through the opening in Douglas' fossa. The peritoneal wound was closed by a row of sutures, but the vaginal wounds in the lacunæ were left open in the middle for iodoform gauze drainage. There was only slight hemorrhage during the operation, which lasted more than two hours. Toward the end of the operation the patient was very much collapsed, cold, and almost pulseless. In spite of the free use of hypodermic injections of brandy from the end of the operation at 2 P. M. until 8 P. M. no reaction had taken place; the pulse of the wrist was 160 and hardly perceptible, and the patient was a little delirious; temperature, 96° F. I then made a transfusion in the median vein of the arm of 12 ounces of a 6 : 1000 solution of salt in sterilized water. The pulse improved somewhat after the transfusion.

June 21st, 8 A. M.: The patient was uneasy all night. She slept very little, if any; pulse very feeble, and can hardly be counted; complains of extreme thirst; has not vomited. 8 P. M.: Condition unchanged.

June 26th: The patient's condition has gradually improved a little. She coughs considerably, and expectorates mucopurulent matter. Complains of frequent and painful micturition. Examination of the urine reveals cystitis, probably caused by a non-disinfected catheter used by one of the nurses. The bladder was washed out twice a day with a saturated solution of boric acid.

June 30th: There is some bloody discharge from the vagina.

July 15th: Patient has been steadily improving; cystitis and cough less; she sits up, is out of bed, and eats and sleeps well.

July 20th: Patient complains of considerable pain in the goiter, with some difficulty in breathing—so much so that aspiration was deemed necessary, and a pint of greenish fluid evacuated, containing numerous cholesterin crystals, pus-cells, and blood-corpuscles.

August 1st: Sutures and ligatures were removed from the vagina, and the fornix presents a healthy granulating surface, 1½ inches broad and ¾ inch in anteroposterior diameter. The patient left for her home.

Case III.—Mrs. C. H., of Chicago, thirty-two years of age, married, was admitted to Emergency Hospital on August 21, 1887, and came under my care. She gives the following history: She did not commence to menstruate until the age of nineteen; menstruation was always scanty, but not painful; she was married at the age of twenty-one, and has one child, eleven years of age. Three years ago her husband deserted her. Nine months ago she went under a "specialist's" treatment for "ulceration of the womb." She did not at this time, however, suffer from any subjective symptoms referable to the genital organs. She has never had pain—slight occasional abdominal pains excepted—or hemorrhage until shortly before her admission to the hospital. She noticed that, from the middle of last winter to this time, she has gradually lost in weight. She does not appear cachectic.

Present Condition.—Patient is somewhat pale, but reasonably well nourished. Heart and lungs are normal. Urine, in quantity and on chemical and microscopic examination, normal. There is a bloody, serous, fetid discharge from the vagina. Vaginal examination reveals an irregular, hard, nodulated mass, occupying the right half of the vaginal portion of the uterus. The granulated surface is about 1 inch in diameter, and shows a peripheral area of grayish-red, rough, granulated appearance, surrounding a central area of a light, yellowish-gray color. Above the tumor the neck feels normal, except posteriorly and to the right, where it is harder than usual. The uterus is movable; no thickening or hardening of the parametria. The ovaries are of normal size; the body of the uterus is somewhat enlarged; the cavity is 3 inches deep.

Diagnosis.—Carcinoma of the vaginal portion, with probable slight extension up into the neck. It was decided to perform total extirpation according to the method of Fritsch and Leopold.

On August 25th, in the presence of Drs. Pickard, Bernauer, Engert, Hall, Otto, and Holmboe, I operated according to the method of Fritsch. The patient had been prepared for the operation in the usual way. The vagina, being very narrow, has to be divided posteriorly. Even after this had been done the space was so small as to make the operation very difficult. The granulating surface of the carcinoma was removed by a sharp spoon, and the surface then cauterized with the 10 per cent. chlorid of zinc solution. The cervical canal, being now fully exposed, was, together with the uterine canal, disinfected by means of cotton dipped in corrosive sublimate solution and iodoform. A ligature was passed through the parametria, and the uterus drawn down with vulsellum forceps; the left parametrium was incised to the extent of 1 inch ½ inch outside of the vaginal portion. The tissue of the left parametrium was now ligated in portions, and then divided between the ligature and the uterus. Four or five such ligatures were applied before the movable portion of the broad ligament could be reached by the index-finger. The ligatures were left long, and the bleeding points and visible vessels between the ligatures ligated separately.

The right parametrium was now dealt with in exactly the same manner. This part of the operation was almost bloodless. These steps in the operation had the effect of making the uterus come down more than an inch, so as to permit the vaginal portion to be well outside of the vulva. Notwithstanding this the detachment of the bladder from the uterus was exceedingly difficult. A curved steel sound in the bladder marked its outlines clearly and the anterior fornix was incised. An attempt to separate the bladder from the uterus with the finger and dissecting forceps proved utterly futile. Every particle of tissue had to be divided with scissors. An attempt to further the separation by most careful use of closed dissecting forceps resulted in making an opening into the bladder ¼ inch wide. This opening was immediately united by a continuous catgut suture, taking in only the muscular coat, and finally knotted in such a way as to draw the opening together like a tobacco pouch.

Finally, after having been obliged to leave *in situ* a thin layer of uterine tissue on the wall of the bladder, the peritoneum was reached and the vesico-uterine fossa opened transversely on each side out to the broad ligaments. A good-sized flat sponge was passed up over and behind the body of the uterus, with a silk loop attached to it. Several vessels and bleeding points had to be secured on the vesical side of the wound. The left index-finger was passed up behind the left broad ligament, and the latter ligated in three portions and cut off from the uterus. The right broad ligament having been treated in the same manner, the uterus was now attached posteriorly only to the tissues between the posterior fornix and Douglas' fossa. This bridge of tissue was divided by scissors and secured by a loop. In endeavoring to remove the uterus there were found a number of long, band-like adhesions between the posterior surface of the uterus and the peritoneum in Douglas' fossa. Separation of these adhesions was followed by very troublesome, although not copious, hemorrhage, a number of bleeding points having to be secured and ligated separately. The ovaries and tubes were left, as they were almost immovably fixed to the sides of the pelvis, but were otherwise of normal appearance. On the removal of the sponge from the pelvis a mass of omentum and a loop of the small intestine came down into the vagina, and were pushed back by another disinfected sponge. The ends of the broad ligaments were secured in the corners of the vaginal wound in the usual manner, and the peritoneal flaps united carefully after cleaning the pelvis with sponges dusted over with iodoform. The center of the vaginal wound was left open on account of the bladder having been penetrated. The vagina was thoroughly disinfected, and, together with the vaginal wound, packed loosely with iodoform gauze.

The after-treatment was entirely aseptic, and the patient was discharged from the hospital.

Case IV.—Mrs. J. M., age thirty-nine, married, was admitted to Emergency Hospital September 6, 1887. The patient resides in Wisconsin. Her family history is good. With the exception of two attacks of typhoid fever in childhood she has always had good health. Menstruation commenced at the age of thirteen, and has always been regular, but it was always accompanied by severe molimina. She was married at the age of nineteen, and has had four children, born respectively one year, three years, six years, and nine years after marriage. The last pregnancy terminated in a premature birth, the child living only a couple of hours.

The patient's health was always good until the time of her last pregnancy, eleven years ago. Since then she has had a white discharge from the vagina, and has been treated for "falling of the womb." She has never had pain. The first symptom to attract attention was the fact that the discharges became offensive and of a darker color. This was first noticed in the spring of 1887. In other respects all went on as usual until July, 1887, when the patient had a severe hemorrhage after her regular period. The hemorrhages became more and more frequent, occurring almost every day.

Present Condition.—Patient is fat, but well proportioned, weighing about 180 pounds. She is pale, but not cachectic. Her general health is good; in fact, she would not have sought medical advice had it not been for the hemorrhages, which alarmed her.

Vaginal examination reveals a nodulated, hard, ulcerating mass occupying the right half of the cervix. The uterus is movable. Right broad ligament rather tense, but not infiltrated. Rectum, vagina, and bladder free.

Diagnosis.—Carcinoma of the uterus.

Treatment.—Vaginal hysterectomy.

After the usual preparatory treatment, the operation was performed, September 12th. The patient was anesthetized with ether and placed in the lithotomy position. The introitus of the vagina was so narrow, from overabundant adipose tissue, that it was necessary to make a perineal incision on both sides. The carcinomatous mass was now scraped out with a sharp spoon, and the vagina thoroughly disinfected. The uterus was seized with heavy vulsellum forceps and drawn down as far as possible. The broad ligaments were so short and unyielding that it was impossible to draw the uterus as far down as in the previous cases, making the operation very difficult throughout.

Bilateral incisions were made; the parametria ligated in portions, as usual, and the uterus removed, which was found to be unusually large. On account of the narrowness of the vagina and the unyielding condition of the parts, the usual method of suturing and closing the wound was abandoned.

This course was the more indicated as during the operation the patient's pulse was very rapid, and toward the end she showed signs of collapse. A rubber drain, surrounded by iodoform gauze, was introduced, and an ordinary antiseptic dressing applied.

At the end of the operation the patient was very weak, the radial pulse scarcely perceptible, necessitating the free use of hypodermic injections of brandy and ether.

The after-treatment consisted of daily irrigation with boric acid, fresh packing of iodoform gauze, and free use of stimulants.

Four days after the operation the rubber drain was removed, but it was necessary to introduce it again two days later, as the discharge became highly offensive. It was kept in for two days, after which iodoform gauze only was used.

From the beginning of the third week after the operation the temperature and pulse became normal and remained so, excepting one afternoon (October 6th), when she was allowed to sit up half an hour, after which her temperature went up to 102° F. She was kept in bed for several days, not being allowed to sit up again until October 13th. Since that time her recovery has been uninterrupted. All ligatures were removed, and the wound entirely closed. Her appetite and general condition are good.

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LIVING AND DEAD OSTEOMATA OF THE NASAL AND ITS ACCESSORY CAVITIES, ILLUSTRATED BY A CASE OF ENCYSTED ORBITAL OSTEOMA ORIGINATING IN THE ETHMOID BONE[*]

SPENCER Watson called attention, in 1868,[†] to the fact that a peculiar form of exostosis not infrequently developed from the walls of the ethmoid cells and the sinuses of the frontal and ethmoid bones. Frequently these osseous tumors developed into the orbit and encroached upon the eye, displacing and finally destroying it by pressure. It was the practical importance of the latter fact that directed especial attention to the so-called orbital osteomata. Cruveilhier had before this shown that osseous tumors were often encysted or surrounded by a peripheral layer of bone. Virchow pointed out that orbital osteomata often developed in the diploë of the surrounding bones, expanding their cortical substance so as to be "encysted" by a layer of the latter, but at the same time he made the distinction between these enostoses and true exostoses originating in the periosteum of the walls of the orbit.

Arnold first called attention to the fact that orbital osteomata often had their primary seat in the surrounding sinuses, and from here later in their growth entered the orbit. The true relation of the encysted osteomata of the orbit, of Cruveilhier, to the nose and accessory cavities, was not thoroughly revealed until 1881, when Bornhaupt,[‡] in an excellent article describing an orbital osteoma originated in the frontal sinus and operated upon by Volkmann in Halle, gathered from the literature not less than 50 cases of these tumors. From Bornhaupt's exhaustive investigations on this subject, the most important points regarding the development, as well as the diagnosis, prognosis, and treatment, hitherto unknown, have been brought forth; and we owe to him our present somewhat thorough knowledge of the subject, together with most valuable practical suggestions as to the rational method of operating for their removal.

Tillmanns[§] has lately called attention to the fact that similar osteomata develop also from the walls of the nasal cavity, and that the dead osteomata described by Dolbeau, lying loose in the frontal sinus, belong to the same class of osseous tumors.

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[*] Jour. Amer. Med. Assoc., 1888, vol. xi, p. 185.

[†] Transactions of the London Pathologic Society. 1868, vol. xix. p. 314.

[‡] Langenbeck: "Ein Fall von linksseitigem Stirnhöhlen-Osteom, nebst Bemerkungen über die in den Nebenhöhlen der Nasen, sich entwickelnden Osteome," Arch. f. klin. Chir., 1881, vol. xxvi, p. 589.

[§] "Ueber todte Osteome der Nasen und Stirnhöhlen," *ibid.*, 1885 vol. xxxii, p. 677.

My attention has been especially directed to this subject by the following case:

Morits Mayer, twenty-four years of age, tailor, was admitted to Cook County Hospital April 27, 1887. He gives the following history: Parents lived to old age, and there is no history of tumors or deformities in any of his ancestors or relatives. Patient had measles when a child, but otherwise has always been strong and healthy. He dates his present illness from 1878, when he was struck by a club at the inner canthus of the right eye, causing fracture of the bones of the nose. In the course of a year a swelling appeared and increased slowly and without pain in the above-named region, causing the right eye to be pushed outward. He thinks the swelling has remained stationary for the last eight years. Five years ago a discharge of pus from the right nostril commenced, and has continued ever since. Four months ago an abscess formed in the inner canthus. It was opened and left two fistulous openings which discharge a moderate amount of pus.

Present Condition.—The patient is well nourished, somewhat pale, but otherwise looks healthy.

On the right side of the root of the nose is a flat prominence which fills up its inner third from the superciliary arch down to the infra-orbital ridge, and extends a little in front of the bridge of the nose. The superciliary region of the frontal bone, that is, the anterior wall of the frontal sinus, is not enlarged or pushed forward. The skin covering the tumor is normal, with the exception of a red, inflamed area around the two fistulous openings. The probe introduced through these finds roughened bone near the surface, and the entire tumor feels hard, as if consisting of bone covered only by skin. The infra-orbital margin can be traced to within a line or two inside the infra-orbital foramen, where it gives place to the hard tumor arising from below.

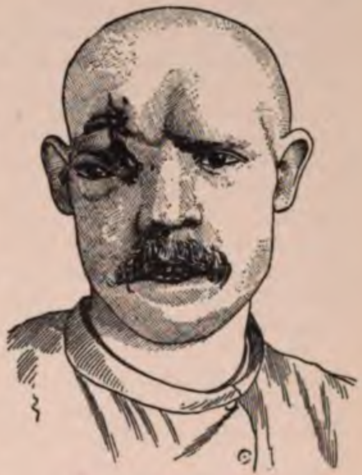

Fig. 51.—Ethmoid osteoma.

The eye is pushed downward and somewhat outward, and on examination by Dr. E. M. Smith, oculist to the Cook County Hospital, presents the following condition: Right eye deviated outward and downward; distance from nasal crest to pupil on left side, 30 mm.; on right side, 50 mm.; consequently the outward deviation is 20 mm.; deviation downward, 10 mm.; exophthalmos, 7 mm. There is slight hypermetropia; the pupil is active; the tension of the eyeball, normal. Ophthalmoscopic examination shows the fundus normal, the optic papilla not swollen, but the veins are somewhat engorged and tortuous. Acuteness of vision good.

Inspection of nose shows, 1½ inches inside the nostril, instead of the inferior and superior meatus and the concha, an irregular mass covered with bluish-red mucous membrane, to which several small polypi the size of a pea are attached.

The infra-orbital region is somewhat prominent in its nasal half, but no distinct tumor can be felt behind the upper lip above the alveolar process of the upper maxilla.

Inspection of the mouth and palate shows no difference between the two sides, and the soft palate and pharynx are normal. Rhinoscopic examination is impossible on account of the thickness and size of the soft palate, the movements of which the patient cannot control. Palpation of the nasopharyngeal cavity with the finger reveals a hard, irregular, rough, bony mass filling up the right posterior choana. A small exploratory incision, dilating the fistulous opening of the tumor, in the inner canthus showed the roughened bony surface of a large osseous tumor which was hard and immovable.

Diagnosis.—Orbital osteoma originating in and being part of a large ethmoid osteoma, the place of origin either in the lower medial point of the frontal sinus or in one of the ethmoid cells.

Operation.—On May 3, 1887, the patient was anesthetized and an attempt made to introduce a Bellocq's tube, with a view to tamponing the right cavity of the nose posteriorly and anteriorly, so as to avoid hemorrhage down into the pharynx. This was frustrated by the tumor in the nose, which made the introduction of the tube impossible. The patient was then placed on his back, with his head hanging downward, to be operated upon in Rose's position. A longitudinal incision was made midway between the eye and the root of the nose, commencing on the frontal bone 1 inch above the orbit, and extending downward 3 inches to the ala of the nose. The incision having been carried down to the tumor, the soft parts were detached by a gouge from the anterior and orbital surface of the latter. The tumor was found to extend far back in the orbit, from 1 inch to 1½ inches. The surface of the tumor is very hard, and the tumor itself is immovable. With a view of getting at the base of the tumor, if it existed, or, rather, of uncovering the mass of the tumor, I removed with the chisel the nasal and frontal portions of the superior maxilla and the right nasal bone, together with the nasal process of the frontal bone. Having thus opened the frontal sinus, I was so fortunate as to find the end of the tumor reaching up, with only a small corner which was not attached to the walls of the frontal sinus at all. Through the large lateral opening into the nasal cavity the tumor was found filling it up, and by grasping with a firm bone forceps it was easily made movable and brought out through the opening. The bony tumor which was formerly felt in the posterior nares was still there, but it was loose and was removed through the same opening as the other tumor. There was now left a large cavity opening into the frontal sinus and posterior nares, and the nasal and submaxillary cavities below. In the orbit the periosteal covering of its inner wall was intact, covering the eye and its accessory organs. The remainder of the cavity was covered with its mucous membrane, on which several small polypi were found and removed.

There was no considerable hemorrhage, and the wound was united and the cavity washed and packed with iodoform gauze. With the exception of a slight rise in temperature on the second day, the course of the after-treatment was aseptic. The iodoform gauze dressing remained until the close of the second week, at which time the wound had united.

Description of Tumor.—The living osteoma weighs 2 ounces, measures 2½ inches in length and 1½ inches in diameter, and is irregular in shape, since it consists of several portions, corresponding to the different cavities which it occupied. These portions, separated by distinct depressions from the central body of the mass, are: (1) The orbital portion, which forms a rather square mass of bone, measures 1½ inches from above downward, 1½ inches in anteroposterior, and ¾ inch in transverse, diameter. Its anterior ridge is denuded and roughened, while the rest of the tumor is covered with periosteum and a thick layer of mucous membrane. The orbital portion reaches from the internal anterior border of the orbit back to the orbital foramen. From the upper inner corner of the orbital portion a small round projection the size of a pea extends up into the frontal sinus. (2) The portion occupying the antrum of Highmore is a rounded pyramid, ½ inch broad, ¼ inch high, and occupies the cavity mentioned, the nasal wall of which has disappeared.

(3) The nasal portion, which forms the bulk of the osteoma, is an irregular square of the above-mentioned diameter in all directions; its inner surface is covered with a thick layer of mucous membrane, from which three mucous polypi the size of a pea have grown out. At the anterior upper corner of this nasal portion is a large polypous growth, ½ inch long, ¼ inch broad, and pedunculated. It contains a small bony nucleus the size of a pea; in other words, forms a small osteoma, by means of a pedicle movable against the large tumor, in which there is a small depression into which it partially fits. The posterior inferior surface of the nasal portion is concave, 1 inch in diameter, and covered with a thick layer of smooth connective tissue. The concave surface forms a cup into which the upper rounded surface of the dead osteoma, so to speak, articulates. On the middle of the inner surface of the nasal portion is found a square plate of the ethmoid bone ½ inch in diameter, which I consider the point of origin of the osteoma.

The cut surface of this large osteoma shows a peripheral layer, ¼ inch in thickness, of extremely hard, compact osseous substance—so hard that a sharp chisel or knife will only with difficulty cut into it, and a smaller central area of cancellous substance, which is so friable as to be penetrated with considerable ease with sharp instruments.

Microscopic examination of the layer of soft tissue covering the tumor shows the following: A layer of cylindric epithelium, under which is a heavy layer of mucous membrane proper containing numerous tubular mucous glands. Finally, nearest to the bone, a layer of fibrous tissue constituting the periosteum.

The dead osteoma is about 1½ inches long, and ¾ to 1 inch in diameter. Its upper surface, which has articulated in the above-described cavity in the large tumor, is rounded, slightly nodular, smooth and hard, like ivory. The rest of the surface is uneven and roughened. Parts of the tumor had been broken off, so that when the whole tumor was put together, it would form a large mass the size of a walnut. The broken surface shows this to consist of a very thin outer shell of very hard, compact bone substance, and within a mass of fine spongy substance, resembling pumice-stone.

On the dead osteoma there is nowhere a trace of any membrane covering it, and it emits a penetrating fetid odor. No odor at all emanates from the living osteoma.

Etiology and Mode of Origin.—Bornhaupt has found in the literature 23 cases of osteomata in the frontal sinuses, 12 cases of osteomata in the ethmoid cells, 10 cases of osteomata in the antrum of Highmore, and 5 cases of osteomata in the sphenoid cavity or sinus—in all, 59 cases of encapsulated orbital osteomata. These seem to be more common than the orbital exostoses, of which the literature furnished him only 7 cases. This class of tumor is more prevalent in youth, 54 per cent. occurring before the age of puberty, 87 per cent. before the thirtieth year—that is, before the final or finished development of the accessory cavities of the nose. It is thus likely that they owe their origin to some disturbance in the development of these cavities.

A traumatic cause has been noted in 6 of Bornhaupt's and in the present case. Considering the general frequency of traumatism in this region, it is very unlikely that it plays any part in the etiology of these tumors.

Whether the tumors originate in aberrating islands of cartilage of the primordial cranium or in an embryonal matrix of the periosteum of the membranous cranium is as yet an open question. The chief argument against the origin from cartilage is that no partly cartilaginous osteoma has ever been found in or around this region. It is therefore more probable that they develop from the periosteum on the walls of the cavities mentioned.

Pathologic Anatomy.—The tumors consist of a mass of bone with a covering of periosteum and mucous membrane.

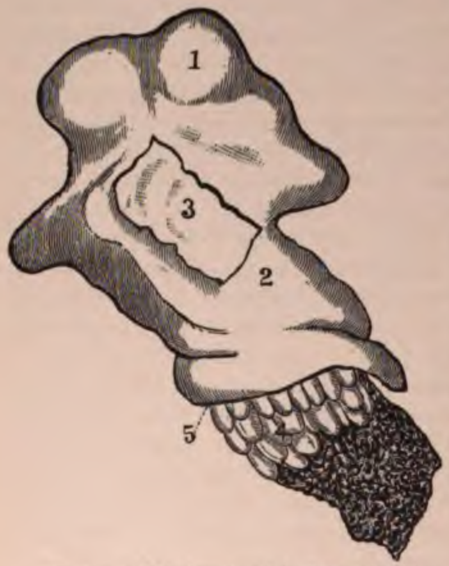

Fig. 52.—1, Orbital portion of the living ethmoid osteoma; 2, nasal portion of the living ethmoid osteoma; 3, lamina of ethmoid bone from which the living osteoma originated; 4, dead nasal osteoma; 5, cavity in ethmoid osteoma in which the nasal osteoma articulates.

(*a*) The osseous mass of the tumor has the following characteristics: The shape of the tumor originally is round. When it enlarges and extends into the orbits or any other adjoining cavity, the form becomes modified. At the place where the tumor passes through the wall or opening into the cavity a contraction or neck forms, on the distal side of which, as if further growth was not now restricted, a roundish, more voluminous portion develops. Thus in the specimen here presented we easily recognize an orbital portion with a depression or neck separated from the larger nasal portion, and at its outer lower point of union with the former a maxillary portion extends into the antrum of Highmore.

The surface of the osteoma is irregularly nodulated.

The tumors are extremely hard, like ivory, especially on the surface. Thus it is impossible to chisel into or cut away pieces of them. On the cut surface we find a hard peripheral layer surrounding a more spongy center. Sometimes a laminated arrangement of the peripheral hard layer is found. The central spongy area has been described as resembling pumice-stone. Whenever the osteomata have a pedicle or base, as when they develop in the frontal sinus, as a rule, the base is composed of spongy tissue. Thus the tumor can be successfully attacked at this place only. It has often happened that while the operator has been engaged unsuccessfully in chiseling at the body of the tumor, it has suddenly become loosened by the breaking of the pedicle.

(*b*) *The Covering of the Tumor.*—All encapsulated osteomata are covered with a layer of soft tissue, namely, first, periosteum, and outside of this mucous membrane. The latter contains the usual tubular muciferous glands of the nasal mucous membrane, and is covered with cylindric or fimbriated epithelium. This layer of mucous membrane is sometimes, as in the specimens here presented, thickened and covered with mucous polypous growths.

Invasion of neighboring cavities takes place where the osteoma has grown too large for the cavity in which it originated. The orbit is most commonly invaded, as its walls participate in the formation of the ethmoid, frontal, and maxillary sinuses. The growing osteoma presses upon the bony wall of the orbit, which at the place of contact atrophies and disappears, and the osteoma, with its covering of mucous membrane, enters the orbit. If the tumor enters from the frontal sinus, the eye is pushed downward and outward; if the ethmoid sinus is the point of origin, the eyeball is dislodged outward. Finally, if the tumor originates in the antrum of Highmore, the displacement will be in an outward and upward direction.

As soon as the orbit is opened, and, in consequence, the mucous membrane covering the osteoma comes in contact with the connective-tissue spaces of the orbital periosteum or the orbital connective tissue, an abscess forms. The microbes present on the surface and in the mucous glands of the mucous membrane invade the lymph-spaces of the affected tissue, and, necessarily, traumatic infection resulting in suppuration takes place. Thus an abscess forms near the inner canthus of the eye. In older cases we find one or more fistulous openings leading down to the surface of the orbital portion of the osteoma.

Far more serious in its consequences is the invasion of the cranial cavity by osteomata developed in the frontal or sphenoid sinuses. The suppuration first between the dura mater and the cranium, later on perforating the dura mater, terminates the patient's life by suppurative leptomeningitis or abscess of the brain.

Bornhaupt found that of 17 cases of osteoma of the frontal sinuses, in 11 cases, or 65 per cent., opening into the cranial cavity had taken place.

Symptoms.—In the beginning the symptoms are not characteristic, as the osteomata grow very slowly, are painless, and cause no inflammation as long as they stay in the cavity in which they originate. Enlargement of the wall of the cavity is often found, and next we find a hard, painless tumor in the inner canthus of the eye.

Displacement of the eyeball is often the first symptom that calls attention to the existence of a tumor.

By filling up the sinus in which it develops and occluding its outlet accumulation of mucus or catarrhal fluid takes place, with subsequent distention, followed by the symptoms characteristic of this condition. Finally, the abscess forms under the conditions described above.

Diagnosis.—An extremely hard, painless tumor of slow growth, at the inner wall of the orbit, accompanied by abscess and fistulous openings resulting therefrom, makes the diagnosis of encysted osteoma reasonably easy. A very important point to ascertain now is the place of origin of the tumor. As above stated, the deviation of the eyeball gives us the most important information in this direction. If the eye is pushed downward and outward, we may expect an osteoma of the frontal sinus; if directly outward, the tumor comes from the ethmoid cells; if upward and outward, from the antrum of Highmore.

Prognosis.—The prognosis depends upon the seat of origin of the tumor. Osteomata of the frontal sinuses must be considered as very dangerous. The mortality after the operation has been, according to Bornhaupt, 64 per cent. Of 11 cases, 7 died from meningitis, or abscess of the brain.

Osteoma of the sphenoid sinus has been operated upon only once by Ferguson. The patient died from collapse shortly after the operation. Other tumors of this variety have not been observed in living patients, but found on specimens in museums.

In the case of osteomata developed away from the cranial cavity the prognosis is entirely different. The ethmoid, nasal, and supramaxillary osteomata are not dangerous and can be removed with safety. Out of 12 cases of ethmoid osteomata, 11 were cured by operation and 1 by spontaneous exfoliation.

Osteomata of the antrum of Highmore give also a good prognosis for extirpation for the same reason as that given for the ethmoid tumors, namely, the absence of injury to the cranial cavity.

Treatment.—The encysted osteomata have no connection with syphilis, and consequently are not amenable to internal medical treatment. Surgical treatment alone comes into question, that is, extirpation of the tumor. Considering the anatomy of the encysted osteomata, as above described, the plan for operating is obvious. We must expose the tumor by removal of its encysting bony walls, find its base or pedicle, and divide the latter, in order to free the tumor. The extreme hardness of the body of the tumor makes any attempt at removal piecemeal by hammer and chisel almost impossible. Knapp worked five hours on a tumor of the frontal sinus and was able to remove only a small piece. He was obliged to abandon the operation, and the patient died from meningitis seven weeks later. Maissonneuve, in trying to chisel off a prominent nodule of an orbital osteoma originating in the ethmoid cells, found such a degree of hardness that he had to work for a long time with all the different bone instruments with which Charrière, who was present, could furnish him before he succeeded in removing even a nodule of the tumor.

If we then cannot attack the tumor from its surface, we must lay it open, expose it by removing with the chisel the bones that cover it, the anterior wall of the frontal sinus, nasal and maxillary bones. When the tumor is exposed, we look for its base or pedicle. Knapp has pointed out that this part of the osteoma is often composed of soft, spongy bone tissue, so that the chisel may be used here with advantage. In operating upon ethmoid osteomata it makes no difference whether the base is hard or soft, because the fine, thin places of the ethmoid bone from which the tumor has grown out break off and fall out with the tumor with almost the first stroke of the hammer. The specimen here presented shows a plate of the ethmoid bone adherent to the tumor.

The removal of the osteomata from the frontal sinus is more difficult, not so much because the plates of the frontal bone are stronger than the thin ethmoid plates, but because we dare not break off the cerebral plate of the frontal sinus for fear of meningitis. We must try to divide the pedicle with the chisel without employing much force, and rather leave part of the osteoma than open the cranial cavity (von Oettingin and Birkett). But even if the most careful manipulation of the instruments is observed, as in Socin's operation, described by Banga, in which the tumor, to the astonishment of all present, became loose by almost the first touch of the hammer, the cranial cavity may be opened with disastrous result.

This often unavoidable danger in operating in the frontal sinus induced Mackenzie and Berlin to advise enucleation of the compressed, inflamed, doomed eye, instead of the radical extirpation of the tumor. However unsatisfactory this remedy seems from a surgical standpoint, it deserves earnest consideration, inasmuch as the osteomata are benignant tumors of slow growth and may in course of time separate spontaneously from their point of origin.

Spontaneous loosening of the encapsulated osteomata takes place not infrequently. Besides the small loose or dead osteomata found accidentally in frontal sinuses, of which Tillmans reports 6 cases, we find a case described by Middlemore, who tried to remove an orbital osteoma but gave up the operation. Nine months later the tumor became loose and was extracted. A similar case is reported by Imre, cited by Tillmans. An orbital osteoma the size of a fist had pushed the eye down to the angle of the mouth. After forty-three years' duration it became loose spontaneously, and the eye returned to almost its normal place in the orbit. Hilton saw a large osteoma of the antrum of Highmore which had destroyed the eye become loose after seventeen years, during suppuration.

Tillmans reports a case in which he removed by operation two loose dead osteomata of the frontal sinuses and an osteoma of the nasal cavity. He points out that osteomata of the nasal cavity have been as yet very seldom reported. Habermaas saw a case in von Bruns' clinic. The tumor had originated in the ethmoid bone, with a pedicle the size of a thumb. It was successfully removed by operation. He remarks that the so-called nasal stones or concrements have sometimes been found to contain a nucleus of bone. This fact makes it probable that dead osteomata of the nasal cavity are more common than has been hitherto believed.

The cause of the spontaneous loosening and death of the osteomata is as yet not satisfactorily settled. Suppuration is generally conceded to be one of the causes.

FIBROCYSTOSARCOMA OF THE UTERUS*

THIS specimen was removed by laparotomy from a woman of thirty-five who had a tumor the size of a child's head, immovably connected with the uterus at the fundus, and also two small myomata that could be felt through the vagina. The large tumor showed fluctuating places on the surface by palpation through the abdominal wall, and I concluded that it was an ovarian cystoma, either located in the broad ligament or sufficiently adherent to the uterus to make them move together. At the operation I found it to be a cystofibroma, or fibrocystosarcoma, subperitoneal, but attached by the broad base to the uterus at the fundus. After temporary elastic constriction around the cervix the tumors were enucleated, and as the uterine cavity was not opened, I united the wound of the wall of the uterus with buried step sutures, deep and superficial, and a final continuous suture along the inverted borders of the peritoneum.

At the close of the operation all hemorrhage had apparently stopped, consequently I did not drain. In the course of the first week some fever set in, and on the tenth day I reopened the lower border of the wound and evacuated about three to four ounces of blood mixed with pus from a cavity surrounding the body of the uterus. The evacuation and subsequent washing out and drainage did not have much influence on the patient's condition; the fever continued; she had a large gangrenous bed-sore over the os sacrum, and died six days later, in the third week after the operation. The autopsy showed no peritonitis, and the cavity with the accumulation of blood and pus was found entirely separate from the general peritoneal cavity. On examining the uterus I found, as you see here, surrounding the line of the uterine wound, an island of gangrenous tissue including the wound and a square inch or more to each side. This gangrene explains the persistence of fever and sepsis, notwithstanding the evacuation and drainage.

The large inner tumor has, you see, a smooth surface. On the cut surface, in some parts, there was an appearance of myoma; in other places, islands of softer tissue looking like myxoma or sarcoma, and in other parts cystic cavities. These cysts have not the usual shape and appearance of cystomata, but are irregular, triangular, or longitudinal sinuses, the walls of which are not smooth but trabeculated, so as to give the appearance, as Dupuytren describes it, "similar to the walls of the ventricles of the heart."

I shall here make a few remarks on fibrocystomata of the uterus, because they are comparatively rare, the whole number described in the literature not being much above 100. Fibrocystomata are, as the name indicates, forms of fibromata or myomata, and it is a comparatively rare change in the preëxisting elements of these tumors that gives them the additional characteristics of cystomata.

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*Jour. Amer. Med. Assoc., 1888, vol. xi, p. 604. Chic. Gynecol. Soc., June 29, 1888.

We distinguish between the following varieties: myxomyoma, as described by Virchow, characterized by edema of the interstitial tissue and by the fluid in the spaces containing mucin; consequently it is something more than a simple edema of the myoma. Spread islands of embryonal cells are also proof of a more active process, terminating in myxomatous or even sarcomatous tissue. Besides the edema in the interstitial tissue of the myoma, we find edema and atrophy of the muscular fibers, isolated fibers or their débris mixed with the fluid in the cavities. These cavities are of all sizes, from the microscopic, as shown on this slide, up to the size of a pin's head or walnut, and we even find cavities of enormous size, containing several quarts of fluid. The cavities are lined with pavement-celled epithelium, or rather endothelium as you would expect, since they originate from dilated lymph-spaces, or naked when the cavity is formed by the disintegration of muscular fibers. The cavities contain clear, colorless, or bloody fluid that often coagulates spontaneously when evacuated—a fact that Atlee pointed out as a differential diagnostic sign in contradistinction to the fluid from ovarian cystomata. A special form is described as fibromyoma lymphangiectodes by Leopold. Distinctly different from this is the myoma teleangiectodes sive cavernosum of Virchow, with multiple cavities from the size of a millet-seed to that of a pea, communicating with the blood-vessels and consequently containing pure blood. These tumors are found to enlarge during menstruation (Virchow), and on auscultation a bruit is heard (Péan).

As to the place of development, the great majority are subperitoneal. Of the 70 cases gathered from the literature by Heer, 63 were subserous, 5 interstitial, and only 2 submucous tumors. They sometimes attain an enormous size, weighing 29, 40, and in one case even 81, pounds.

The cystofibromata are most often found between the ages of thirty and fifty. The symptoms are in the main, of course, the same as those of common myomata and fibromata. Uterine hemorrhage is rare because, as before mentioned, they rarely develop close to the mucous membrane. A more characteristic symptom is a sudden enlargement, probably from acute increase in the size of the cysts or from intracystic hemorrhage. The spontaneous coagulation of the fluid would be a valuable symptom if it was constantly found, but in about 70 cases it was noted in only 11 (Herr). It might, however, in reality be more frequent, since in a number of cases it might not have been noticed (Gusserow). The lack of vitality shown by the tendency to local gangrene is also somewhat characteristic of these tumors. Thus Grammaticati, as stated by Gusserow, saw a myoma the size of a child's head, located in the wall of the cervix, undergo superficial necrosis, followed by sepsis and death.

It is rather noteworthy that a correct diagnosis was rarely made. They were almost always mistaken for ovarian cystomata, and a number of them were punctured. Puncture, however, in this form of cystoma is far more dangerous than in other cystomata, as shown by Leopold, who found that, as a consequence of puncture, 10 patients out of 11 died. McGuire, therefore, is right in asserting that exploratory laparotomy is less dangerous than puncture.

The treatment should be entire extirpation, because of the probability of rapid enlargement, the danger of puncture, the liability to gangrenous or septic changes, and thrombosis of the vessels in and around the tumor. Gusserow gives a series of 41 laparotomies with 22 recoveries, the cause of the high mortality being the necessity of the removal of the uterus in some of the cases. Occasionally the operation cannot be finished; thus, according to Gusserow, in 38 cases, 7 were unfinished, and of the 7, 6 patients died. That an exact diagnosis, with a definite premeditated plan of operation, is of extreme importance is shown by Gusserow, who, out of 11 cases described in the literature, reported 9 recoveries.

A few words about uterine sarcomata, inasmuch as the tumor here presented is a mixed form of cystofibroma and sarcoma. In the uterus we distinguish between circumscribed and diffused sarcoma, the former originating in the muscular wall of the uterus, the latter in the mucous membrane. The circumscribed uterine sarcomata are of the most interest to us in this connection, as they stand in near relationship to fibromyomata and fibrocystomata. They form, usually, round, circumscribed, harder or softer tumors, looking like, and developing in the same places as, the fibromyomata, and so similar to these that we must class the relapsing fibromata of Paget among the sarcomata. But besides more or less typical fibrous or muscular cells, here we find islands of short, spindle-shaped, round or polymorphous cells, or islands of myxoma tissue—in general, a more vivid cell-formation than in fibromata and myomata; and we further find in the same tumor in different places different forms of cells. So predominating, however, are fibroma or myoma tissue cells that Schröder regards it as a law that the circumscribed sarcomata are always formed by transformation of fibromata. According to Gusserow, the transformation of fibromata into the mixed form of fibrosarcomata, myxosarcomata, and cystosarcomata is so rare that the literature shows very few well-observed cases of this kind. By examining the microscopic slides that I exhibit tonight we find, in some portions, apparently typical myofibroma tissue, without or with dilated lymph-spaces, in which we find granulated matter containing loose or isolated muscular cells; in other places islands of typical myxoma tissue, here and there islands of embryonal cells; in another part of the tumor territories of short, spindle-shaped cells, large, and with oval or round nuclei; in other words, islands of unmistakable sarcoma tissue; and, finally, places of common typical, round-celled sarcoma tissue.

As to the age in which fibrosarcomata of the uterus are found, there is this difference from the cystofibromata, that, while they both are most common between the ages of thirty and fifty, the sarcomata are still common between fifty and sixty, while the cystofibromata, as we have seen, stop at the age of fifty.

As regards treatment, the sarcoma is a malignant tumor and needs more extensive removal or radical treatment than the benignant cystofibroma. The removal of subserous or interstitial fibrosarcomata by abdominal supravaginal extirpation and extraperitoneal treatment has often been followed by a growth of sarcomatous tissue in the cicatrix in the abdominal wall. The abdominal total extirpation of the uterus can hardly be said to have lost much of its dreadful mortality of about 70 per cent. from the time of Freund's first operation until now.

In the treatment of this case the following suggestion occurred to me—a suggestion which was not carried out because of the patient's death. I should operate as I did, enucleating the subserous tumor, and if the uterine cavity was not opened, try intraperitoneal treatment of the stump. After recovery from this operation, if the microscopic examination of the tumor proved it to be a fibrosarcoma, I should follow, as soon as the patient's strength would permit, by vaginal extirpation. In the rare cases in which the size of a diagnosed circumscribed uterine sarcoma or fibrocystoma will permit of vaginal extirpation this operation is, of course, the only one indicated.

The two other specimens are not strictly gynecologic, as they occurred in men. However, they had this in common with gynecology, that laparotomy had to be done.

COLLOID CARCINOMA OF THE CECUM*

THIS specimen is a tumor of the cecum—a so-called colloid carcinoma. The patient was a man of about forty, in whom, for about six months, an increasing tumor had developed in the middle of the abdominal cavity. When I saw him the tumor was of the size of the head of a child of four, was somewhat movable from side to side and up and down. There were never any disturbances on part of the intestines, but emaciation and considerable pain. I thought it a tumor of the omentum on account of its mobility, also that it was malignant because it was hard, nodular, and of rapid growth, but I did not think of the intestine being the seat because there were no symptoms. When the abdominal cavity was opened, I found this large nodulated tumor with a great many adhesions to the omentum and some to the intestines, and finally, having separated these and applied a great many ligatures, when I got the tumor isolated and out through the abdominal wound, I found the ileum passing into one side of the tumor and the ascending colon coming out of the other side. I then divided the ileum and ascending colon two inches away from the tumor, detached and ligated the mesentery, and, after the removal of the tumor, closed the ileum and ascending colon in the usual way by invagination and suture, and made an anastomosis between the lower end of the ileum and upper end of the ascending colon by means of Senn's decalcified bone plates. The territory of approximation was covered by an undetached omental flap. I preferred this operation to circular resection or implantation of the ileum into the colon, because of the shortness of the plate operation as compared with the others. The patient lived four days, was able to take some liquid nourishment, had no vomiting, no tympanites, showed no symptoms of sepsis or peritonitis, but gradually became weaker and died. The autopsy showed no peritonitis, the ends of the upper and lower bowel were closed, the closed ileum and closed end of the ascending colon, and at a distance of 2½ inches the anastomosis covered with the omental flap, which did not adhere. The peritoneal surfaces between the plates are perfectly united, allowing of no escape of liquor or air. The passage between the ileum and colon is perfectly free, as you see after opening the opposite wall of the intestines. The tumor shows at this point the ileum entering the large irregular cavity containing some liquid feces, slightly tinged with blood, and at the upper end of the cavity is the ascending colon. This enormously thickened wall of the cavity, 1½ to 2 inches in thickness, is the carcinomatous intestinal wall, the cut surface presenting the characteristic gelatinous appearance of colloid carcinoma. This form of carcinoma has as its characteristic, in distinction from other carcinomata, colloid degeneration of the cells, causing them to enlarge, meet, and form this transparent gelatinous substance. While we do not recognize a colloid carcinoma as distinctly different from carcinomata in general, as we know that partial colloid degeneration is common in all carcinomata of the intestinal tract, clinically we recognize the extremes of this degeneration as a distinct form, characterized by its enormous size, and not uncommon in the stomach, large intestine, and peritoneum. In the peritoneal cavity there were no secondary tumors nor were the lymph-glands of the mesentery invaded. This is what we should expect, as this colloid carcinoma is, as a rule, relatively benignant, with little tendency to the invasion of distant tissues or organs.

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*Jour. Amer. Med. Assoc., 1888, vol. xi, p. 606. Chic. Gynecol. Soc., June 29, 1888.

The death of the patient I ascribe to the fact that when the vitality has been lowered to a certain point by malignant tumors, without or with functional disturbances of vital organs, the organism loses its power to sustain more than a certain amount of operating, and death will follow from the yet unexplained exhaustion, in spite of the absence of all the common well-known fatal complications.

DOUBLE CARCINOMA OF THE COLON *

The third and last specimen is from a man between forty and fifty who had suffered terribly from difficult passages from the bowels for a number of months. Finally a small, almost immovable tumor, appeared to the right of the umbilicus, and later on distention of the small intestines, with pain and vomiting. Every half-hour or hour there would be a paroxysm of peristaltic contractions with excruciating pain. He finally asked to be relieved at any risk. On account of his extreme emaciation and weakened condition I thought it out of the question to attempt extirpation, and resolved to try to relieve him by means of anastomoses between the intestine above and below the stricture. Laparotomy revealed the tumor to be a carcinoma of the ascending colon; consequently I united the lower part of the distended ileum with the empty transverse colon 5 to 6 inches away from the tumor. The patient did not get much relief, and died ten days after the operation, growing gradually weaker, as in the other case. The autopsy showed no peritonitis, the omental flap was partially adherent to the intestine, the peritoneum between the plates united, but at the distal end of the plate, in the colon, an island of necrosis of the intestinal wall from pressure atrophy caused by the plate. Thus in this case perforation of the intestine was only a question of a short time. The carcinoma of the ascending colon, as the specimen shows, is 3 inches long and has caused almost complete occlusion of the bowel. The reason why no relief followed the operation was found below the anastomosis in the splenic flexure of the colon, where a second carcinoma had developed, causing, as you see, almost complete obstruction of the colon. This second carcinoma was not discovered during the operation, as it was hidden high up under the spleen. The emptiness of the transverse colon, together with the rarity of a second carcinoma, was the cause of my not suspecting its presence. If it had been discovered, the anastomosis would have been made between the ileum and the sigmoid flexure, of course. The mortality from even palliative operations upon the intestines is large, because, as a rule, the patients do not come to us for operation until they are exhausted by serious intestinal disturbances, usually of long continuance. This is so generally the case that collapse, even after a short operation, is of frequent occurrence.

Senn's operation of intestinal anastomosis with the plates does not take any more time than the abdominal operation for artificial anus. The last operation here mentioned was of thirty-eight minutes' duration from the time of the incision in the abdomen to the dressing of the abdominal wound.

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*Jour. Amer. Med. Assoc., 1888, vol. xi, p. 606. Chic. Gynecol. Soc., June 29, 1888.

A CASE OF TRAUMATIC CYST OF THE PANCREAS*

Chester A. King, aged eight, was admitted to Emergency Hospital October 6, 1887, with the following history: He had enjoyed good health up to recent illness. Eleven weeks ago he fell from a horse and sustained injury to his abdomen, showing a red spot over the umbilicus, and a similar spot over the processus spinosus of the third lumbar vertebra. He complained, during first eight weeks, of intermittent attacks of pain, located in the region about umbilicus. About three weeks after injury a swelling appeared in the epigastrium and has been increasing steadily since. After injury the patient lost appetite; his bowels were loose, irregular, and the feces of a whitish, curdled appearance, according to his mother's statement. Vomiting had been a prominent symptom during the period from the time of injury until his admission into the hospital. He had been treated for typhomalarial fever.

Status Præsens.—Patient is of normal size for his age, but thin and emaciated. Examination shows lungs and heart normal. In the epigastrium and upper half of mesogastrium is a round prominence caused by a tumor 7 inches in transverse diameter, 8 inches in longitudinal diameter. Percussion over the tumor is dull on the right side, continuous with the liver dulness, on the left side reaching over the border of the ribs. Between the seat of dulness of the tumor and heart-dulness there is a tympanitic area from the ventricle. The circumference of abdomen at the end of the xiphoid process, 24 inches; midway between this and the umbilicus, over the most prominent part of the tumor, 25 inches; at the umbilicus, 23½ inches. After inflation of the bowel with Richardson's syringe the transverse colon is seen passing along and over the lower border of the tumor. The tumor moves with the respiration. There is transmitted pulsation from the aorta, but no expansion or bruit. Over the surface of the tumor is a feeling of fluctuation. The tumor is slightly movable from side to side.

Exploratory puncture brings out a syringeful of deep straw-colored, not perfectly clear, fluid of alkaline reaction, which contains a small number of red blood-corpuscles, but no other formed elements. The location of the tumor is in the median line behind the stomach, above the transverse colon—that is, in the region of the pancreas. Taken together with the microscopic character of its fluid contents, containing no other formed elements than a few blood-corpuscles, and finally its relation to a distinct trauma, made the diagnosis of a pancreatic cyst rather plausible. It was resolved to operate by laparotomy in two tempos, if the thickness of the cyst-wall would permit of such procedure. October 9, 1887, after the usual preparations for laparotomy, a longitudinal incision was made in the linea alba, about 3 inches long, midway between the umbilicus and the xiphoid process. After opening the peritoneal cavity the parietal peritoneum was stitched to the skin and the mesocolon was divided longitudinally and a few small vessels ligated. Beneath this was the glistening white smooth surface of the cyst-wall. This was united by a circular row of fine silk sutures, including a space about 2 inches long and 1 inch broad, to the abdominal wound. No cyst-fluid escaped along any of the sutures, and consequently the original plan of operating in two tempos was carried out. The wound cavity was packed with iodoform gauze; an antiseptic dressing was applied, held in position by an elastic bandage. The following day the temperature rose to 101.5° F., but came down to normal the evening of the same day and remained so. No other untoward symptoms followed this operation.

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* Reported with statistics by A. Holmboe, M.D., Chicago Med. Jour. and Examiner, 1888, vol. lvi, p. 74.

On October 16th, a week after the laparotomy, the patient was again anesthetized, and the cyst opened by Paquelin's cautery. The cyst-wall was of considerable thickness —about ¼ inch. About 40 ounces of thin, yellowish, semitransparent fluid escaped. A large drainage-tube, over ½ inch in diameter and 9 inches long, was introduced to the bottom of the cyst, passing upward and backward toward the left side of the vertebral column, behind the stomach. No irrigation was used at the time of the operation, but a heavy antiseptic dressing and an elastic bandage were applied.

The following day the temperature rose to 101° F., but became normal the next day and remained so. His bowels were regular before the second operation. After this, however, they did not move for five days, when an enema was given. Later on the bowels again became regular. There was profuse discharge the first four to five days after the operation, after which time the discharge rapidly decreased in quantity. When leaving the hospital, November 9th, the dressing which had been applied four days before was perfectly dry. At no time during the after-treatment was there any erosion or maceration of the skin surrounding the wound, although it was constantly in contact with the secretion from the cyst-wall.

The depth of the fistula at the time of leaving the hospital was 3 inches. The general condition of the patient was greatly improved.

In an article on "Complicated Diseases of the Pancreas and their Surgical Treatment" Karl Hagenbach, in Basel, has collected reports of 15 cases of true cysts of the pancreas.* Adding to these 15 cases the reports of 3 cases operated upon in this country during the latter part of 1887 (Bull, Fenger, Steele), we find, altogether, the following 18 cases of cysts of the pancreas so far reported in literature:

From the tabulated cases on p. 508 the following résumé may be drawn:†

There were 11 males and 7 females.

Age from 8 years (Fenger) to 46 years (Küster).

Trauma was given as the cause in 3 cases (Kulenkampff, Senn, Fenger).

Duration from five weeks (Senn) to 13 years (Gross). In Kramer's case the time has been indefinitely given as "some weeks."

Place of development is not stated in 5 cases; in 2 cases the head is given as the seat of origin; in 11 cases, the tail.

As to symptoms, a certain suddenness of onset is noticeable in a number of the cases; otherwise, common gastric and intestinal disturbances seem to be most prominent. Location, relations, etc., of tumor have only in a limited number of cases been sufficiently characteristic to warrant a diagnosis of pancreatic cyst (Senn, Küster, Subotik, Gussenbauer, Bull, Fenger, Steele).

Icterus is mentioned as a complication in 4 cases.

Diabetes in 1 case (Bull).

Sixteen cases were operated, of which 10 recovered and 5 died.

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* Deutsche Zeitschrift für Chirurgie, 1887, vol. xxxiii.

† For further details, see original reports.

Methods of operating* are distributed with the respective results as follows:

Extirpation of the whole cyst: 3 cases with 2 deaths and 1 recovery.

Partial excision of cyst-wall, uniting the remainder with the abdominal wound: 2 cases with 2 deaths.

Puncture and aspiration: 1 case with 1 death.

Incision and drainage in one tempo: 4 cases with 4 recoveries.

Incision and drainage in two tempos: 5 cases with 5 recoveries.†

From the above figures it seems reasonable to conclude, as Senn stated in his monograph of 1885, that the operation to be recommended for cysts of the pancreas should be incision and drainage, and it seems to be a matter of little or no importance whether this operation is performed in one or two tempos.

Careful chemical analysis of the cyst-content has been made in several cases, showing the presence of tyrosin, leucin, mucin, serum-albumin, sodium and potassium salts, etc. The cyst-fluid has also proved itself able to digest starch, emulsify fat, etc., and thereby established its pancreatic origin. In Gussenbauer's and Senn's cases a digestion eczema was noticed around the abdominal wound. The quantity of the cyst-fluid varies from a pint up to several quarts. Blood in varying quantity is frequently found in these cysts. Küster considers the presence of blood characteristic, even for pancreatic cysts, when found in a cyst of the upper abdominal region (Hagenbach). In Thiersch's and Gussenbauer's cases blood was prevalent to such an extent that Hagenbach considers it doubtful whether these two cases can, properly, be classed under retention cysts, believing it possibly more correct to place them among hematomas. Senn, however, thinks it safe to classify them as hemorrhagic retention cysts.

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* Method of operating employed in Dr. Steele's case was incision and drainage; but if in one or two steps, I do not know. Recovery.

† Bull's case was operated on July 19th, discharged cured November 19th, but died two weeks later from diabetes.

LITERATURE.	SEX AND AGE.	CAUSE.	DURATION.	PLACE OF DEVELOPMENT.	SYMPTOMS.	COMPLICATIONS.	DIAGNOSIS.	METHOD OF OPERATION.	RESULT.	CYST CONTENTS.
1. Gross: Anatomical Museum of Boston Society for Med. Improvement, 1847, p. 174.	M. 40 years	....	13 years	Head of pancreas	Loss of strength, bloody stools, tumor in epigastrium.	Icterus	....	....	....	300–400 gm. serous bloody fluid.
2. Salzer: Zeitschr. f. Heilk., 1886, vol. vii, p. 11.	F. 42 years	....	12 years	Tail of pancreas	Growing tumor	Icterus	Ovarian cystoma	....	....	4500 gm. thick, slimy grayish-brown fluid.
3. Bosemann N Y Med. Record, 1882, vol. xxi, p. 46.	F. 41 years	....	7 years	Near the tail	Pain in regio iliaca, emaciation, swelling of abdomen on left side	....	Ovarian cystoma	Extirpation of the pediculated cyst	Healing in 38 days	10 liters brown fluid.
4. Kulenkampff: Berl. klin. Wochenschr., 1882, vol. viii, p. 103.	M. 39 years	Trauma	6 months	....	Tenderness in epigastrium	....	Echinococci of the liver	Incision (2 tempos), drainage	Healing in 6 weeks	1½–2 liters clear fluid.
5. Dixon: N. Y. Med. Record, 1884, vol. xxv, p. 304.	M. 42 years	....	11 weeks	Head of pancreas	Sudden pain in epigastrium, vomiting	Icterus	....	Puncture and aspiration	Death 5 weeks after operation	Abt. 300 gm. light-yellow, slimy fluid.
6. Senn: Journal of the Amer. Med. Assoc., 1885, vol. v, p. 237.	M. 19 years	Trauma	5 weeks	Tail of pancreas	Pain, vomiting, emaciation, tumor	....	Cyst of the pancreas	Incision (1 tempo), drainage	Healing in 7 weeks	3–3½ liters slightly opalescent fluid.
7. Salzer: Zeitschr. f. Heilk., 1886, vol. vii, p. 11.	F. 33 years	....	11 years	Tail and body of pancreas	Backache, vomiting, tumor in epigastrium	....	Ovarian cystoma	Extirpation of cyst	Death 6 days after operation	5 liters yellowish-brown clear fluid.
8. Kramer: Centralbl. f. Chir., 1886, vol. xiv, p. 23.	F. 16 years	....	Several weeks	....	Abdominal pain, tumor in epigastrium	....	Echinococci of the liver	Incision (1 tempo), drainage	Healing in 4 months	2 liters clear fluid.
9. Koetz: Inaug	F. 36 years		8	Tail	Enlargement of abdo-		Ovarian cystoma	Partial exci-	Death in 7	2½ liters brown thick

13. Zukowsky: Wiener med. Presse, 1881.	F. 36 years	....	2½ years	Tail	Tumor in epigastrium	....	Ovarian cystoma	Partial excision	Death tenth day	5 liters brownish fluid, albumin, cholesterin.
14. Thiersch: Berl. klin. Wochenschr., 1881, vol. xvii, p. 591.	M. 38 years	....	1 year	Tail	Took suddenly sick, tumor in region of the stomach	....	Abscess of abdominal wall	Incision (2 tempos)	....	3 liters chocolate-colored fluid.
15. Gussenbauer: v. Langenbeck's Arch. f. klin. Chir., 1883, vol. xxix, p. 355.	M. 40 years	....	11 weeks	....	Took suddenly sick with vomiting and gastric pain; emaciation, epigastric tumor	....	Cyst of pancreas	Incision (1 tempo), drainage	Healing in 12 weeks	1900 gm. grayish-black fluid.
16. Bull: N. Y. Med. Jour., 1887, vol. xlvi, p. 376.	M. 45 years	....	10 months	Tail (?)	Sudden pain, vomiting, dyspnea, loss of appetite, emaciation, stearrhea	Icterus, diabetes	Cyst of the pancreas	Incision (2 tempos), drainage	Recovery. (Death later from diabetes.)	118 oz. dark-brown fluid.
17. Fenger.........	M. 8 years	Trauma	11 weeks	Tail	Pain in epigastrium, vomiting, loss of appetite, emaciation, tumor in epigastric region	....	Cyst of the pancreas	Incision (2 tempos), drainage	Healing in 2 months	40 oz. straw-colored fluid.
18. Steele*.........	M.	....	....	Tail	Tumor in epigastrium	....	Cyst of the pancreas	....	Recovery	....

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* This case is not yet reported, which accounts for my meager information concerning it.

EXTIRPATION OF THE RECTUM*

THE removal of the rectum is an important subject, as it is one of the achievements of modern surgery. Extirpation of the rectum is a child of modern surgery, inasmuch as it was not until iodoform gauze was used for packing and drainage that it became devoid of its dangers. In former times it had such an appalling mortality that colotomy was preferred by the English surgeons, and the removal of the rectum regarded as an almost not permissible operation.

Volkmann made the first step toward utilizing antiseptic principles and reduced the death-rate, but this method of drainage with permanent irrigation was cumbersome, complicated, and often, in cases where the peritoneal cavity had to be opened, dangerous. I have seen in such a case the abdominal cavity filled with more than two gallons of carbolic acid solution; thus it was not until the advent of iodoform gauze that a radical change came about. I have paid a good deal of attention to these operations, inasmuch as I have extirpated the rectum 16 times—11 times for carcinoma and 5 times for inflammatory stricture. As far as carcinomata are concerned, I will in this connection present two specimens, the one illustrating a low carcinoma, as I prefer to call it—a carcinoma that involves the sphincter, and one, a high carcinoma, that is, a carcinoma that has left the sphincter and a couple of inches of the rectum intact. The first specimen is a low carcinoma, consequently the anus is there. The carcinoma, as may be seen, takes in the anus and about three inches of the rectum, and behind it there is a mass of adipose tissue from the concavity of the sacrum, in which we see a tumor the size of a walnut, which is a carcinomatous pararectal lymph-gland. It is always advisable to remove this tissue just the same as to remove the axillary glands when a carcinoma of the mamma is operated upon, or the submaxillary glands when operating for carcinoma of the lips, because this is the place where the carcinoma first extends outside of the rectum to the lymph-glands in the surrounding tissues.

The other specimen is what we might term high carcinoma, inasmuch as the anus and lower portion of the rectum are left. As will be seen, there is a ring-shaped carcinomatous tumor, 2½ inches long, occupying the entire circumference of the gut, ulcerated on the nodular surface, making a constriction which hardly permits the passage of the little finger. At the upper and lower part of this ring is ¾ inch of healthy wall of the rectum transversely divided, thus showing that the anus with the sphincter has been left.

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*Read before the Chicago Medical Society, May 20, 1889. Medical Standard, 1889, vol. vi, p. 1.

As to the method of operating, I want to distinguish between the operation for low and high carcinoma. Low carcinoma includes the anus, and will seldom if ever go up so high that there will be necessity for any more preparatory operating than to remove the coccyx; very rarely, with a view of getting more operating room, it may be necessary to resort to the next step in the higher operation, namely, division of the left sacrosciatic ligament, which gives a good deal more room.

In the operation of high carcinoma the next step in getting access to the rectum is to remove the left half of the sacrum, as proposed by Kraske, or even to remove it entire transversely on the line of the third foramen, with subsequent replacement *in situ*. This latter way of getting operating space I have tried once and found satisfactory; the patient survived the operation, and died six weeks later from causes independent of it, after everything around the rectum had healed satisfactorily.

The two operations, of which the one for low carcinoma might be termed extirpation or amputation (Holmen), the one for the high operation, resection (Volkmann), are, of course, entirely different, inasmuch as the former commences at the anus, extending from there upward, and the other commences above and behind the anus, and is really a posterior operation in the sacral region. The reason for distinguishing between the two operations, besides the entirely different technic, is also the difference in gravity of the operation. This means a different gravity of the disease, namely, that a high carcinoma is much more serious than a low carcinoma. Statistics which I got together a year ago in this respect showed 18 high carcinomata, with a mortality of 50 per cent., while a series of 272 operations for mixed high and low carcinomata showed a mortality of 22 per cent. In most of the statistics we meet with now no distinction is made between high and low carcinoma, in the sense in which I wish to express it; that is the reason why the older mortality does not enable us to judge about a single case, inasmuch as it is too low for high carcinoma and too high for low carcinoma. Old statistics of Billroth showed a mortality of 39 per cent.; more recent statistics of König showed a mortality of 24 per cent. Quite recently Bramann published 27 of von Bergmann's cases, with 26 recoveries and 1 death—that is, 3.6 per cent. mortality.

As to the carcinomata I have operated on, in four high carcinomata—2 men and 2 women—there were 2 deaths as the immediate consequence of the operation, and 2 recoveries from the operation, of which 1 died six weeks afterward, after everything around the anus had been healed. The second, the patient from whom this specimen was taken, is well, has gained 20 pounds in a few weeks, and is much improved by the operation.

For low carcinoma I have operated 7 times on 6 men and 1 woman, with 4 recoveries and 3 deaths, 2 of which were in immediate consequence of the operation. The third died from arterial hemorrhage after four weeks.

A new field for extirpation of the rectum, or the low operation, was proposed by Israel in 1883, namely, to operate in this way for non-malignant inflammatory strictures, whether due to syphilis or to the gonoccocus. This form of diesase of the rectum will sometimes resist all other local measures, dilatation, division, etc., but will form perirectal abscesses and fistulas, make life unbearable, and finally terminate in amyloid nephritis and death. In so intractable a case I have reason to believe that extirpation of the rectum is a decided success. I have done five extirpations for inflammatory stricture, on 4 women and 1 man, with no deaths.

In 16 cases of this nature, reported by Israel, Busch, Riegner, Bardenheuer, and myself, there were 15 recoveries and 1 death—a mortality of about 6 per cent. The possibility of extirpation of the rectum for non-malignant stricture of course depends upon the extent of the latter. It must be possible to reach reasonably healthy rectum above and draw it down. In the case of limited stricture, when the operation has been applied, all the authors agree that the patients have been decidedly benefited.

The advantage of the removal of such a stricture, if it is possible to get good healthy wall of the intestine, is that the disease is done away with at once. There are always foci of pus in the wall and the tissues surrounding such a rectum, and finally, around a stricture of this kind, most irregular pus-cavities form enormous pockets, which are, of course, done away with by the extirpation of the stricture when possible. When the stricture is above a certain point, then extirpation becomes impossible.

To return to the subject of discussion for tonight—the carcinomata: There are some points of importance in the operations which I shall now call attention to, for instance, in operating for high carcinomata it is sometimes very difficult to bring the upper portion of the bowel down, because the mesorectum or lower portion of the mesentery of the sigmoid flexure may be unusually immovable. The mesentery must, of course, be divided until the bowel comes down. A good deal of dissecting may have to be done before the bowel can be brought down. In this respect I believe it is often possible to know beforehand about this difficulty, inasmuch as I think that the longer the stricture has existed, the easier the operation will be, because the efforts at defecation will make the upper portion more movable, and thus make the operation easier. It has often seemed to me also, when I came to a certain point in dissection, that then the upper bowel has come down easier; at the same time I have met with one case where it was almost impossible to get the upper intestine down. When united to the anus or lower portion of the rectum, there must be no tension at all, inasmuch as the sutures can seldom be kept aseptic, and thus are liable to tear through. The danger of tension is shown in a number of Kraske's cases, where, in the same night of the operation, the sutures gave way, the end of the upper bowel turned upward in an effort at defecation, which took place right into the peritoneal cavity. Kraske believes that preparatory treatment of such a patient to the extent of having the bowels entirely emptied might guard against such an accident, but I consider it rather doubtful whether any preparatory treatment can always guard against such a fatal defecation, when rupture of the sutures takes place. I do not see how this can be absolutely guarded against, but the more movable the bowel and the more freely it is brought down, the less tension there is, and, of course, the less liability to this accident.

Furthermore, it is sometimes impossible in high carcinoma by any method of examination before the operation to tell the exact extension of the carcinoma to neighboring organs. My attention was called to this in one case, a woman I operated upon two years ago in Milwaukee. I found that the carcinoma extended to the wall of the uterus from the anterior wall of the rectum—so much so that it was impossible to get all the carcinomatous tissue out, and, further, it was impossible to unite the peritoneum. The patient died from acute septic peritonitis in a few days.

To what extent the difference in prognosis will be between the high and low carcinomata I do not know that it is possible to tell, because this distinction has not been made sharply enough. Thus there is nothing to judge by from the older statistics; it is possible only to guess about the high carcinomata.

It is a great gratification to modern surgery to see that such results as have been described as following operation for high carcinoma are possible. The suggested mortality of 28 per cent. makes this operation a justifiable and a useful one.

One word as to the final results. In my limited experience there is only one case of carcinoma in which I can say that the cure is probably radical, inasmuch as more than two years have passed without a relapse. Of the rest of them, there are two who are now alive without a relapse, but they are so recent that nothing can be said about their future.

Freedom from relapse may to some extent depend upon the form of carcinoma. The more glandular or typical cylindric-cell carcinoma is more benign; the more mixed glandular or small-cell carcinoma is more malignant.

RUPTURE OF THE KIDNEY*

I WILL commence with the case of rupture of the kidney, which was as follows:

Otto Lehmann, twenty years old, from Rockford, Ill., came into my hands February 3, 1888, and gave the following history: He had always been strong and healthy until about a year ago, when the following accident occurred: While walking along a wooden sidewalk built about 5 feet above the ground, he stepped over the side and fell to the ground. He experienced the most violent pain in the right lumbar region, had to be carried home, and any attempt to move him aggravated the pain. There was some blood in the urine for perhaps a week; after that time the urine became normal; nevertheless, he lost greatly in flesh and strength, the pain in the right side remained, and a swelling formed. When I saw him, a year after the injury, he was pale, somewhat emaciated, and in the right side there was a fluctuating swelling reaching from the ribs to the pelvis and to the median line. His temperature was 101° F., showing some fever all the time. An exploratory puncture showed this swelling to contain urine, which was slightly turbulent and contained a few pus-corpuscles. The operation was lumbar incision and drainage; 1 quart of fluid was evacuated from the swelling, but the fever remained and after several weeks even increased, the temperature varying from 101° to 103° F., with profuse sweats and progressive emaciation. I concluded then that suppuration or sepsis was going on, that the most natural location of that sepsis was the tissue of the kidney, and I resolved on extirpation.

I extirpated the kidney on April 12th by the usual lumbar method and T-shaped incision. At that time there was found, besides the kidney, which is here presented, a large abscess cavity extending up toward the diaphragm and down in the large pelvis. After the operation the condition of the patient was not improved; he gradually got worse, and finally exhibited symptoms of inflammation in the corresponding lung, from which blood and pus were expectorated, and he died May 3d, three weeks after the extirpation.

The kidney, which was removed one year after the original injury, presents the following appearance: It is divided into two portions, an upper and larger, and a lower and smaller, one, with a transverse place of division in which there is an opening through, which leads into the portion of the pelvis belonging to the lower portion of the kidney; otherwise the tissue of the kidney is normal. When the pelvis was opened, it was found that the lower portion of the kidney was excluded from the pelvis by the transverse mass of cicatricial tissue seen in the specimen. I therefore think it likely that the urine contained in this space was from the lower portion.

The autopsy showed an abscess cavity in a portion of the kidney, extending to the lower surface of the liver, in the right lobe of which was an abscess the size of a hen's egg, communicating with a subdiaphragmatic collection of pus between the convexity of the right lobe and the diaphragm. From the latter abscess cavity a communication existed through an opening in the diaphragm, up into the pleural cavity, in the lower half of which was an empyema which had perforated into the lung tissue and emptied into a large bronchus of the lower lobe.

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*Read before the Chicago Medical Society, May 6, 1889. Jour. Amer. Med. Assoc., 1889, vol. xii, p. 901.

I wish to make a few remarks on the class of cases to which this specimen belongs, namely: subcutaneous ruptures or injuries to the kidney.

One hundred and eight cases of subcutaneous injury to the kidney have been collected lately by Grawitz.* Of these 108 cases, we can judge of the severity of the lesion by the fact that 50 died. As to the etiology, we can distinguish between direct and indirect injury to the kidney. The direct injury is by a blow, by a foreign body, falling against a sharp edge, as a rail on a railroad track, being driven over by a wagon-wheel, the kick of a horse, a heavy body falling against the side of the patient, etc. The direction of the body that causes the injury is not necessarily directly over the kidney; it may strike the anterior surface of the abdomen or either loin, as well as the side. Indirect injuries, which are also known as ruptures, may be an injury to the whole body, for instance, a man falling from a great height or from a horse to the level of the ground, not striking against any portion of the body in particular. This was true in this case, in which the boy fell 5 feet down on the level ground. Also when a laboring-man digging a well is buried by the caving in of the earth the same thing is shown. Such injuries, acting diffusely on the abdomen, do not cause local symptoms, ecchymoses, abrasions, etc., but sometimes fractures of the lower ribs or of the spinous processes of the vertebræ point to a severe injury.

As to frequency, Grawitz remarks that it is probable that subcutaneous injuries to the kidneys are more common than is usually believed, and much more common than these 108 cases would imply, inasmuch as there undoubtedly are a number of cases where the hematuria is slight, passing off in a week, and so they are not recognized or published.

As to the anatomy, direct violence can, of course, crush the kidney tissue; a slight injury may cause a rupture which is limited to the tissue of the kidney without opening either into the pelvis or capsule, or it may open into the pelvis and capsule, or may rupture also the peritoneal covering of the kidney, or, finally, the whole kidney may be crushed. The slighter injuries almost always present themselves, as in this case, as ruptures, and the direction of the rupture is almost always the same as in this case, transverse, so that the kidney is divided into an upper and a lower portion transversely, whatever the direction of the body causing the injury may have been. This has its explanation, says Grawitz, probably in the fact, first, in the fetal shape of the kidney, consisting of numerous small lobuli, 12 to 15 in number, "renculi," as they are called, divided from one another by transverse sulci. It has been shown by Hatayama, in experiments on animals with transverse lobulation of the kidneys, that when a rupture is produced, it is a transverse rupture. Attempts to determine this by Grawitz and Caspar Leman, by rupturing the kidney on dead bodies, have not been successful: it seems as though life is necessary to produce rupture of the kidney in that way. The natural consequence of rupture of the tissue is hemorrhage, and the quantity of blood is, of course, variable, according to the extent of the injury. The larger the vessel, the more the extravasation.

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*Langenbeck's Arch. f. klin. Chir., 1885, vol. xxxi, p. 419.

The following points should be taken into consideration as to the danger of immediate hemorrhage: If the capsule is not ruptured, then the blood will dissect away the tissue of the kidney from the inner surface of the capsule and there will come a time when the tension here becomes extensive enough to stop the hemorrhage mechanically. If the capsule is ruptured, extensive extravasation in the pararenal tissue may take place and form a hematoma that may extend from the diaphragm to the pelvis, but even here there will finally be some tension which will tend to stop further extravasation. When the peritoneum is ruptured over the kidney, then the blood has access to the peritoneal cavity, and, of course, there is no tension that will have a tendency to stop the hemorrhage, consequently these are the cases in which there is most danger of acute fatal hemorrhage. In children, rupture of the peritoneum is more common than in older people, partly because the peritoneum is thinner and partly because it is more tense over the surface of the kidney. If the pelvis of the kidney is ruptured, then the blood goes down the renal passages and appears in the urine, except where there is a simultaneous rupture of the ureter.

As to the symptoms: pain is almost always present, and this pain is usually so violent that patients are unable to walk or stand. Shock is not particularly characteristic for injury to the kidney, but, when connected with anemia and followed by collapse, points to severe intraperitoneal hemorrhage. A tumor is felt only in case of rupture of the capsule and extrusion into the perirenal tissue. Hematuria is almost constantly present, rarely entirely absent, but often of short duration only. It is slight in small ruptures, copious in rupture of large vessels of the pelvis, and sometimes intermittent when a coagulum temporarily stops up the ureter. It may be intermittent when the thrombosis that is primarily found in the vessel later disappears, for instance, if it is being washed away with urine; the result of coagulation on its passage down may be renal or vesical colic. The hematuria usually lasts from one to two weeks; it is very seldom that it stays as long as the fourth week.

As to the course and termination, the following is known: Fifty-eight cases out of 108 recovered. The course is usually divided into two stages—a non-suppurative primary and a suppurative secondary stage. It is an error to divide the course of such an injury in this way, inasmuch as a given case does not necessarily pass from one into another; consequently, it would be as well to divide them into cases where we have healing by first intention, on the one side, and healing by second intention and suppuration, on the other side (Grawitz); or to divide them into aseptic and septic cases. Aseptic healing took place in 46 out of 58 recoveries (Grawitz). In the milder cases the blood disappears, pain ceases, and recovery takes place in one to three weeks. In severe cases it took one to three months. Experiments made by Maas on animals to determine the effects of crushing and rupture of the tissues of the kidney show that aseptic healing is the rule, even when there is extensive crushing of a large portion or all of the kidney, by aseptic atrophy with absorption of the dead tissues and replacement with connective tissue, and compensating subsequent hypertrophy of the other kidney. This takes place in from eight to thirty days, usually. Suppuration took place in 17 out of the 108 cases, or in 10 of the recoveries. The cause of the suppuration, of course, need not be discussed—it is microbes, pus-microbes, perhaps, but microbes. This was suspected as far back as in 1869, when Billroth's assistant, Menzel, and Simon mentioned it, showing for the first time that healthy urine does not produce suppuration, but that decomposing urine does; but they left it uncertain whether it was the ammonia in the decomposed urine or the microbes, which Billroth had then paid considerable attention to, which caused the suppuration. Tillmans states that extensive crushing of the area of the kidney tissue, when no suppuration takes place, causes only a limited parenchymatous inflammation around the dead tissue. Aseptic silk sutures through the kidney tissue do not cause suppuration, but will heal just as well as in any other tissue. A diffuse parenchymatous nephritis from traumatism is rare, and has been described in only three cases.

The sources of infection are the blood, the urinary passages, and, finally, the abdominal organs. The blood is very rarely a source of secondary infection to crushed tissues mixed with urine. Rinne has shown that putting woolen threads through the kidney tissue, although they cause more mechanical injury than do silk or linen, will heal antiseptically, even when pus-microbes have been injected into blood-vessels or into the peritoneal cavity before, at the time, or after the threads have been put in, which speaks very strongly for the blood being only occasionally the carrier of the microbes to infect the crushed tissue. The urinary passages, then, are the ones to look to, and, of course, any previous condition in the shape of gonorrhea or cystitis, or, what from the history of the numerous cases seems to be well proved, in some of them at least, from catheterization with an unclean catheter after a rupture which has caused coagulation of blood in the bladder has caused the infection of the injured portion of the kidney. The course of the suppuration is the following: either a perirenal abscess or, what is more grave, suppurative nephritis; multiple abscesses in the kidney tissue, either acute or chronic, the acute being by far the most common.

Death took place in 50 cases out of the 108—a mortality of 46 per cent.; but of these cases there were a number with complicated injuries of the abdominal and thoracic organs, which ought to be excluded from subcutaneous injuries to the kidney; when these have been excluded, there remains a mortality of 35 per cent. (Grawitz). The most common cause of death is immediate hemorrhage—the patient dies within a couple of hours or within the first day or two; that is, when the pelvis is opened and the large vessels of the kidney ruptured. The rupture of the peritoneum does harm mostly by not giving resistance enough in helping to check the hemorrhage, inasmuch as blood and urine, when aseptic, even in considerable quantities, are, as has been shown by Wagner, readily absorbed from the abdominal cavity. Later continuous hemorrhage that comes on in the two or three following weeks takes the life of some patients, but only half as many as the primary hemorrhage (in 8 of Grawitz's cases). Then comes the suppuration or sepsis, which is, as has been seen, in the minority; suppurative nephritis, paranephritic abscess, peritonitis, pleuritis by extension of the abscess, or metastatic. Finally, suppression of the urine rarely causes death (in 3 only of Grawitz's cases), and, of course, depends upon the condition of the other kidney, either both kidneys being crushed or the remaining kidney being unhealthy.

PRIMARY CARCINOMA OF THE KIDNEY*

THE patient, J. P. Bakken, a man of thirty, came from Red Jacket, Michigan, in April, 1888, and gave the following history: He had always been healthy, and was considered a strong and robust man; worked in a mine. Two years previously, while at work in the mine, he suddenly felt a pain in the region of the kidney and went home; was laid up for some time. A diagnosis was not made, but he had a pain in that side, nothing characteristic that would call anybody's attention to the urine, and, finally, after some weeks, he got on his feet again and concluded to go to his native country, Sweden, for his health. He stayed there, and one day, while jumping about 8 feet from a rock down to the ground below, suddenly felt a pain in the left lumbar region, and from that time there was blood in the urine. During the whole year there was blood in the urine—sometimes less, sometimes more, often very considerable quantities, so as to make him rather anemic. When he came to me he had lost strength, had not felt able to return to work for some time, and when examined, the urine was mixed with blood in rather large quantities. There could be felt enlargement of the kidney, not very distinct, but still distinct enough to make it different from the other side, and, as in all cases of hematuria, I looked for pieces of tumor over and over again, and finally found a small shred of tissue showing round, oval, and club-shaped cells, that made me believe the tumor to be a sarcoma. This decided an operation, which was nephrectomy, by the lumbar method. The patient became comatose the day after the operation, and died with symptoms of uremic coma on the third day. No autopsy permitted.

The kidney shows the following characteristics: There is a round tumor on its anterior surface, 1½ to 2 inches in diameter. Its smooth surface is covered by the distended capsule of the kidney. Its posterior surface bulges into the pelvis, the upper part of which is perforated by a sessile, polypoid projection of the tumor. The apex of this projection is rough and jagged from destruction of the mucous membrane, shreds of uncovered tumor tissue protruding from the surface and being the source of the hematuria. A transverse section through the tumor shows irregular cavities in the center filled with coagulated blood, in one instance so near the surface as to give the sensation of fluctuation. Microscopic examination shows the typical characteristics of carcinoma, with only a slight amount of connective tissue and large alveoli, lined and filled with large round and polymorphous cells; these cells have large round or slightly oval nuclei, surrounded by a large granular protoplasm or cell body.

I will say a few words about primary carcinomata of the kidney in connection with this case. Carcinomata as well as sarcomata are usually found at two different periods of life, viz., from one to ten, and from fifty to seventy, years. Carcinomata are unilateral and most common on the right side. They are more common in men than women, in contradistinction to sarcomata, which are more common in women. Heredity is doubtful, but a congenital origin seems to be plausible in the carcinomata of children. Traumatism is not uncommon.

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*Jour. Amer. Med. Assoc., 1889, vol. xii, p. 903. Chic. Med. Soc., May 6, 1889.

As to the anatomy, there are some points which are new in the literature, and which P. Wagner, in a recent article, has called attention to.* It was usually supposed that carcinomata originated from the epithelial cells of the urinary canals, but a number of carcinomata were found in which the cells did not look like urinary epithelial cells at all, but did look like the large cells in the suprarenal capsule. Then it was demonstrated by Klebs and Grawitz that erratic islands of suprarenal capsule tissue were found in the kidney substance near the capsule. It is, therefore, likely that many carcinomata having this kind of cells develop from these islands.

Clinically, we may distinguish between a more benignant and a more malignant form of carcinomata. The relatively benignant form is of slow growth; may remain stationary for years; has late metastasis or not at all, and is always unilateral. The average duration of the disease in adults is from one to two years; one of Wagner's cases lasted seven and a half years. The malignant form is characterized by rapid growth, softness of tissue, early diffusion, and early metastasis is common in children, where in a few months growths of enormous size form. Cystic softening of the center and hemorrhage within the tumor are common. Carcinomata often open into the pelvis, as in the case here described, causing hematuria, but in cases of this kind it is rare that fragments of the tumor are loosened and found in the urine.

The symptoms are naturally similar in carcinoma and sarcoma. The tumor is always found later in the disease, and may attain an enormous size, especially in children. It is often nodular, with fluctuating areas corresponding to cysts or hematomas within the tumor. Out of 50 cases, Ebstein found a palpable tumor noted in 47, the symptoms thus being absent in only 3 cases. Hematuria is rather a common symptom; it is natural that there should be blood in the urine as soon as a tumor, carcinoma, or sarcoma opens into the pelvis of the kidney and the covering mucous membrane is destroyed by pressure atrophy and hemorrhage. It is quite possible that the presence of urine on the surface of such a tumor makes hemorrhage more common by washing away clots. In a collection of 75 cases of adults with carcinoma, Rohrer found hematuria in 23. In 50 cases of children Leibert found hematuria in 19. Ebstein, in 50 cases of all ages, found hematuria in 24. The origin of the hematuria is almost always from the carcinoma when it has perforated into the pelvis or ureter. Rarely, it may come from the other non-carcinomatous kidney. In a case described by Kühn he found in the pelvis of the right non-carcinomatous kidney a teaspoonful of blood and a coagulum in the ureter. He believes the hemorrhage due to overdistention of the glomeruli from overwork of the organ. The hematuria is sometimes slight, sometimes profuse. It is usually found in the beginning of the disease, according to Leibert, in two-thirds of the cases of hematuria, ceases after a while, and does not reappear in the later course of the disease.

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* "Casuistische Beiträge zur Chirurgie," Deut. Zeitschr. f. Chirurgie, 1886, vol. xxiv, p. 505.

As to the degree of hemorrhage: it is rarely so profuse as to prove fatal. It is not uncommon that, as in this case, the hemorrhage is started by traumatism. Sarcoma is said to be less commonly followed by hematuria than is carcinoma. Neumann gives as the cause of this that sarcomata have less tendency to open into the pelvis than carcinomata. Hemorrhage rarely occurs in the beginning, then ceases, then recurs toward the end; still more rarely does it occur toward the end and not in the beginning. Albuminuria is seen sometimes independent of hematuria. The presence of pieces of tumor in the urine is not a very valuable diagnostic sign, because they can seldom be found. The mistake that I made here from the cells which I thought to be sarcoma is one that Rosenstein has pointed out. Small dislodged pieces of surface epithelium from the pelvis of the kidney, with its club-shaped cells, may look like and be mistaken for sarcoma. A safer method of diagnosis is to make an exploratory aspiration from within the tumor and get out a little piece of tissue in the hypodermic syringe, which will often give a piece large enough for diagnosis. Pain is often absent. When present, besides having its seat in the region of the kidney, it radiates toward the ribs and down the femur. Pain is not only commonly absent, but it is not characteristic of malignant tumors, as compared with an inflammatory condition of the same region. The diagnosis between sarcoma and carcinoma is an ideal one, as the treatment is the same. No symptoms exist to make such a diagnosis outside of anatomic means.

As to the treatment by extirpation, it was said by Gross that the results are so miserable that extirpation of the carcinomatous kidney should be entirely given up. Sarcomata in children should not be extirpated, and the only malignant tumors of the kidney where extirpation should be permitted are sarcomata in adults, especially in women, and more especially in floating kidney. It is possible that when an earlier diagnosis can be made, earlier operation may make the prognosis better. The majority of surgeons, in Germany at least, believe that this will be so. The arguments in favor of operation are that the disease is usually unilateral, both kidneys being diseased in only 10 per cent. of the cases (Wagner), and, further, that the relatively benignant forms have a slow growth and late metastasis. Rohrer, in 115 cases, found none in which the peripheral lymph-glands were invaded.

The prognosis of extirpation is grave in young children who have slight power of resistance against extensive operations, with great loss of blood; the prognosis is also grave when the operation is performed so late that the patient is already cachectic. Gross collected 49 cases of nephrectomy for carcinoma or sarcoma: 30 died during or shortly after the operation; of the remaining 19, 10 died within a few months from continuance of the growth, and 6, all of which were cases of carcinoma in adults, lived only from one and a half to five years. The prognosis of the operation was most grave in children: of 16 children, 9 died from the operation, 4 shortly after, and 3 were not afterward heard from.

As to the method of operating: Laparotomy is more dangerous than lumbar extirpation, the respective percentage of mortality being as 64 is to 45. Consequently, the lumbar operation should be always preferred when the size of the tumor will permit. The longitudinal or oblique incision gives too little space, therefore a T-shaped incision is preferable. Von Bergmann has recently proposed an interior oblique incision, the same as for ligation of the aorta and common iliac, pushing the peritoneum inward from the anterior surface of the tumor.

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